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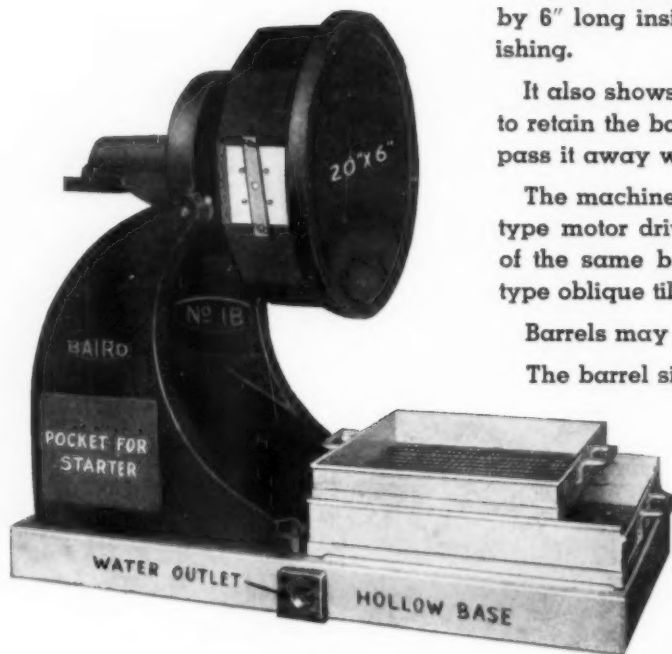
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# NEW BARRELS FOR SMALL WORK



The picture at the left shows a closed barrel, 20" inside diameter by 6" long inside with wooden linings on sides for ball burnishing.

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are essential to

# GOOD PLATING

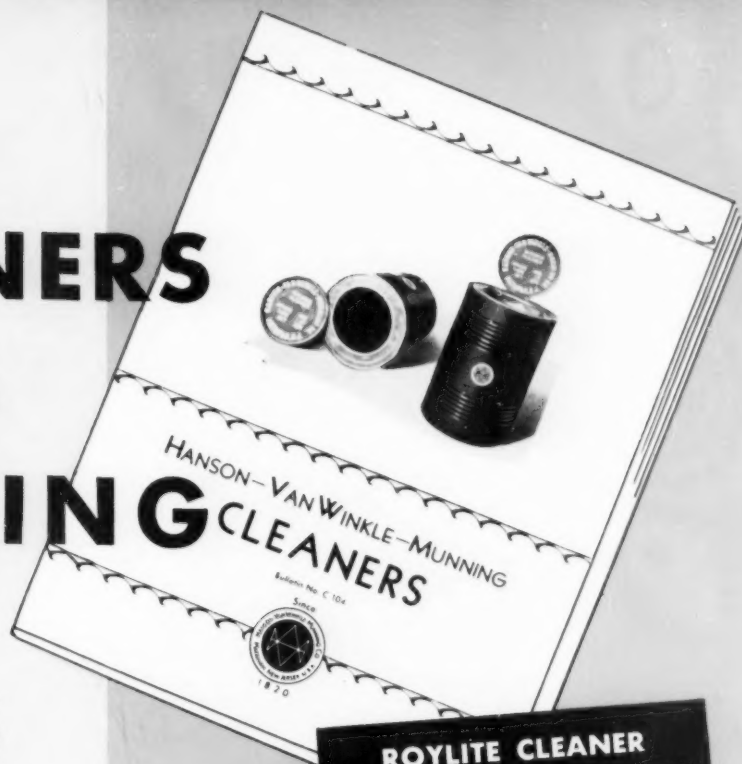
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# WHAT'S IN A NAME?

Because, back in 1870, an importer of chemicals decided to turn manufacturer in order to supply the early electroplaters with the first cast nickel anodes and salts, electroplating was greatly stimulated in the United States, and the Hanson & VanWinkle Company was launched as a leader in its development.

... a position reasserted by the manufacture of the first successful dynamo in America for the deposition of metals.

... a leadership maintained by new developments for this fast-growing industry, and strengthened further when, in 1927, the Hanson & VanWinkle Company and the A. P. Munning Company joined forces to form the present Hanson-VanWinkle-Munning Company.

What's in a name? The evolution of metal plating and finishing is so closely interwoven with the history of this Company that the growth of the industry has seemed virtually dependent upon the new equipment, processes, and supplies which the Hanson-VanWinkle-Munning Company has continually developed. For well over a century a host of fundamental developments have all been originated by this Company.

But a name may quickly lose its lustre, so today Hanson-VanWinkle-Munning is as active and progressive as ever in research, manufacture, and service to buyers. Still "Plating and Finishing Headquarters," the Company maintains a staff of experts who are at your service to assist in solving your finishing problem by tried methods, or to tailor new equipment to its measure.



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# METAL INDUSTRY

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FEBRUARY, 1940

## Plating on Aluminum

The Travers method of plating on aluminum appears, at first glance, to be quite contradictory to our usual concepts regarding the preparation of metal for plating. In the usual plating procedures, care is explicitly taken to insure the obtaining of a clean metal surface, free from oxide inasmuch as any oxide present will ordinarily result in poor adhesion of the applied coating.

Previous to the Travers process, the technique for plating upon aluminum included methods for dipping or pickling which would dissolve the oxide coating, and immersion treatments were used which would deposit metal, such as iron or zinc, upon the surface to lessen or reduce tendency towards oxide formation, which is present even when the work is immersed in water. The deposited metals, of course, have another function, which is to minimize the chemical displacement reaction between aluminum and the metal to be electrodeposited.

In the Travers process, an oxide film is deliberately built up on the surface of the aluminum object which is to be plated. This oxide is given a so-called activating treatment, which usually does not remove the oxide coating, but rather probably produces many fine pores in the coating, which facilitate the access of the plating solution to the base aluminum.

Nickel both from ordinary gray nickel solutions and from bright nickel solutions, is deposited directly upon the oxide coating with a resultant strong bond. The rationalization of the mechanism of this plating procedure is somewhat difficult, but the adherence obtained and the deposition which is possible may be correlated with the following factors:

Aluminum oxide has a valve action to the passage of electrons, and in the case of deposition upon the oxide where the work is made the cathode, the valve action is in a proper direction for metal deposition. Deposition may, therefore, possibly occur directly upon the oxide.

However, the most likely mechanism is that the resistance of the oxide results in high focii of current at the pores in the oxide, which accomplish rapid deposition of metal throughout the interstices of the coating, resulting in a bond which is due to some molecular adhesion with the base aluminum, from mechanical entrapment in the interstices, and from adsorptive action between the aluminum oxide lattice interface with that of the electrodeposited nickel.

## On Electroplating Nomenclature

A diversity of spelling and usage of terms or words may be observed in the technical literature on electroplating. First of all, the word "electroplater" is being variously spelled as "electro-plater" and "electro plater".

Mr. T. F. Slattery of Washington, D. C. was largely responsible for the changing of the spelling of "The American Electro-Platers' Society" to its correct spelling "The American Electroplaters' Society" although, judging from letterheads and programs recently received, all the branches of this society have, as yet, not adopted the official spelling.

The word "data" has been used incorrectly so often that its correct use may sound strange. The word "data" is the plural form of the word "datum" and thus to say "this data shows" is as incorrect as saying "this facts shows" or "this children is".

The word "electrolyte" is being generally used with a dual meaning. Strictly speaking the word refers to those salts or substances in solution which conduct electric current but it is being widely used to designate the solution of the electrolytes. Complete agreement has not been reached on its use.

Lastly, the designation of the substrate of electrodeposits as "the basis metal" rather than "the base metal" hardly appears to be a pleonasm especially in a statement such as—"The basis metal was steel". Surely we have outlived the alchemical viewpoint of metals.

# Chromium Plating of Motor Cylinders

By Hendrik Van der Horst

*Hilversum, Holland*

The idea of plating cylinders with chromium occurred to the author after reading an article by an authority on internal combustion engines, who suggested that cylinder wear might be attributed to chemical attack instead of abrasion. I thought that perhaps chromium might be the answer. We all know what amazing results have been obtained with hard chromium plated gauges and tools. An improvement of 20 times the durability is not unusual. Why not apply the same principle to cylinders? I felt that if I could get a coating of chromium to adhere to the cast iron block, the bore would not be affected by chemical attack from the products of combustion.

Successful experimentation resulted in the Van der Horst process, known as "chromium-hardening". This name was chosen to describe the process because, at that time in Holland, the term chromium plating was synonymous with peeling bicycle handlebars. The process has had most amazing results. Several engineers in the United States are already quite sure that a 15-fold reduction in wear is not an overly optimistic expectation. This means that the cylinder block is going to outlast the engine. Consequently, the door is opening to possibilities of doing away with liners and other means now used to counteract cylinder wear.

A firm in Amsterdam which makes Gardner Diesel engines has discarded dry liners and now employs cheap cast iron instead of high-grade alloyed metal for cylinder blocks. In the long view, then, the chromium hardening of cylinder bores does not increase the cost of the engine. Rather, it decreases it. The wear of piston rings—ordinary run-of-the-mill piston rings—is reduced by as much as 75% with chromium plated bores. Wear on the piston ring groove is also cut down appreciably. A plant of ours

The author was the pioneer plater of heavy chromium deposits in Europe. He describes the plating of large pistons and cylinders of Diesel engines applying a porous deposit of chromium which holds lubricating oil and can be readily honed. The "racking" of work is a real engineering job considering that 20,000 amperes may be used on one piece of work. Tanks 18 feet deep are still too small to meet the growing demands of industry. Chromium plating of cylinders includes those of tractors, Diesel locomotives and marine vessels.—Ed.

patentable subject matter. During the development work, we found that the so-called bright chromium plating process would not serve our purpose. While it is one thing to get a thick coating of evenly distributed chromium to adhere to a cylinder, it is another problem to get the engine running well on it. It is well known that chromium metal does not hold lubricating oil. Chromium particles break out of the coating, embed themselves in the piston skirt, and produce an area of fine scratches.

To eliminate this scoring, we apply porous chromium—more porous than coarse-grained cast iron. Oil adheres to this because it simply fills the holes. We cannot explain how we plate this porous chromium, but we emphasize the fact that it is a necessity. Without it, chromium plating of cylinders is useless until someone finds another way of preventing picking up of metal particles. Besides preventing scoring, highly porous chromium has another advantage. It can be honed.

Naturally, our work is not perfect. Sometimes the chromium plated bores are slightly "undersize". Correcting this by means of honing on a dense, smooth chromium surface is not feasible commercially. But it is an easy job on a porous chromium layer. Excess metal to the extent of from one-half to one thousandth of an inch can be removed in less than two minutes by honing.

## *Plating Fixtures Expensive*

As to the plating job itself, we



*H. Van der Horst*

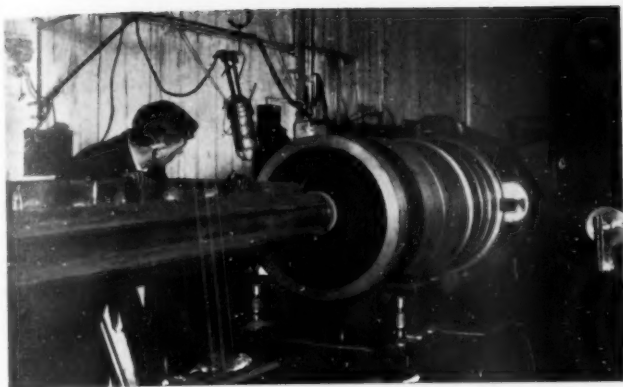


Fig. 1. Grinding of a large 22" ship cylinder previous to chromium plating.

found we had to specialize in order to make a proper job of it. When working upon cylinder blocks, we begin by making anodes and equipment which center the anodes properly in the bores. We are careful to insulate the parts of the anodes outside the bores in order to prevent current lines from straying to large outside areas. This would upset our timing and cause tapering off of the plate or bare patches at the ends. At the tops of the anodes, we place copper rings, connected by copper strips. The high cost of making jigs and fixtures necessarily makes a high cost for each new type of block to be plated. For example, a large marine liner costs us as much as \$2,000—before we start plating!

#### High Current Density Used

The current density varies according to the type of work. On the above-mentioned cylinder block, we apply from 450 to 650 amperes per sq. ft. On large pieces, we use lower current densities for various reasons. For one thing, because of the heat, as it is extremely difficult to apply 20,000 amperes on a single point. The metal will melt at any point with a slightly increased contact resistance—as is evidenced by the pear-shaped drops of iron on the bottom of the tanks.

The solution differs greatly from the one commonly used for decorative chromium plating. We usually apply 0.006" of chromium on the diameter except when we have to build up used blocks to the original bore. In such cases, we apply as much as 0.024". Building up used blocks is a difficult job which hardly pays for itself, since all irregularities increase with thickness. We must never reach a point where serious treeing occurs, because we then lose control and as a result, nasty-looking—though harmless—pock marks are left on the bore.

To plate a cylinder block or liner with chromium, takes from 80 to 90 minutes, sometimes longer, depending upon the previous finish and the state of the solution. On the crankshafts, we always put 0.006" on the diameter in such a way that it requires no further finishing. We meet the standards set by engineers, but in all our hard chromium jobs, we try to eliminate finishing by grinding. It is true, we always hone cylinders, but only to make them smooth; never to remove surplus metal.

#### Plating Cylinders

We definitely do not rely on the hardness of chro-



Fig. 2. This 10,000-ton ship with 8,500 H.P. has 24" cylinders, chromium plated.

mium metal. It is far more a matter of corrosion resistance and friction coefficient. For example, we treated cylinders for the fuel research station, a division of the British Government. They ran three test engines, using coal dust as fuel, which causes extreme cylinder and ring wear. Tests were made with an ordinary alloyed cast iron cylinder, with one containing a nitrided liner, and one with a chromium hardened bore. The chromium plated bore and the nitrided bore were approximately equal in hardness—about 1000 Brinell. The cylinder wear rates for the cast iron bore and the chromium plated bore were in the ratio of about 70:1, while wear rates for the nitrided bore and the chromium-hardened bore were in the ratio of 10:1. It must be borne in mind that a nitrided surface gets soft quickly after



Fig. 3. Salvaging a large undersize engine shaft by nickel plating. Note the portable plating tank used.



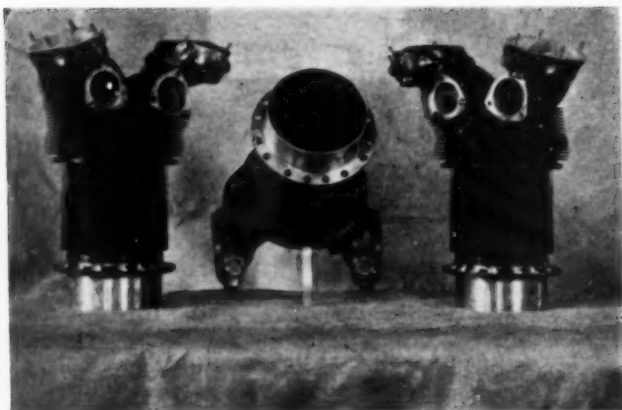


Fig. 4. Steel airplane cylinder barrels, chromium plated.

wear has set in.

The character of the wear was unusual. Commonly, there is heavy wear at the top of the ring travel, and little at the bottom, but the coal dust fuel caused cylindrical wear all along the ring travel.

It is of interest to note that the chromium plating effected a large reduction in the wear of the top piston ring.

Anyone who wishes to undertake the chromium plating of cylinders cannot confine himself to electroplating. The finished job goes far beyond it. When a motor manufacturing firm starts this work, we make it a con-

dition that a competent engineer takes the instruction. He must be a man who has an all-around knowledge of the processes that precede plating and of the honing that follows. Furthermore, he must be thoroughly familiar with the engine. He should know how the engine performs with cast iron bores and what changes will result from applying chromium. Once the engineer has made sure of the mechanical strength of his machine, we will take care of the wear problems and assure a smoothly running engine with chromium plated bores.

#### **Much Power Used**

In the Netherlands, we have developed cylinder plating into a thriving business. In Hilversum, a town of 70,000 inhabitants, our plant consumes for hard chromium plating, 11 per cent of the city's total electric current. From 70 to 80 per cent of this is used in treating huge cast iron motor ship engine liners 5 to 12 feet in length with bores ranging from 20 to 32 inches. Our largest tank, 18 feet deep, does not meet the demands made upon us. We have no sooner finished plating a propeller shaft that is just about all we can manage, than engine builders and owners ask us to attempt still larger pieces. Already, we have been asked to plate main engine crankshafts. In these, a length of 30 feet is considered small. When we feel reasonably certain that chromium hardening will be beneficial in this case, we will undertake the job.

## **Photomicrographs of Diatoms Present in Filter Aids**

(Courtesy of Dicalite Co., New York)



Photomicrograph of elongated types of diatoms. Mag. 270x.



Photomicrograph of spicular diatoms. Mag. 270x.

# Glycerine in Metal Processing

By

Georgia Leffingwell, Ph. D.

and

Milton A. Lesser, B. Sc.

## Glycerine in Plating

In the field of modern metal processing and metal treatment, glycerine today plays a widely diversified role. It is used not only in electrometallurgical processes, but also in tempering processes, soldering materials, protective coatings, metal polishes, lubricants and the like.

The worth of glycerine in the metal industries arises from a unique combination of important physical and chemical properties. Pure glycerine is a clear, water-white viscous fluid that is about one and one quarter times as heavy as water, with which it is fully miscible, as it is with alcohol. Glycerine, however, does not mix with ether, benzene, gasoline and similar organic solvents, a factor which is of notable importance in many processes. The high boiling point (290° C.) of glycerine, and the low freezing points of its solutions (a 65% solution in water freezes at -43° C.) are also very considerable characteristics. Among the most notable properties of this fluid, one must however, include the hygroscopic nature of glycerine, by which it can absorb and retain water, even up to 50% under certain conditions. Since it is a trihydroxy, aliphatic alcohol, glycerine lends itself readily to many chemical processes and to the synthesis of many valuable glycerine derivatives, which find important applications in metallurgy.

In electrometallurgical processes, glycerine finds varied uses in electroplating solutions and as an ingredient of compounds associated with such methods. Thus, glycerine is advocated as an ingredient not only of nickel plating solutions, but also of nickel stripping solutions. For example, a nickel plating bath has been suggested as follows:

Nickel sulfate	4 oz.
Nickel ammonium sulfate	6 "
Boric acid	2 "
Glycerine	1 "
Water	1 gal.

Similarly, a solution for stripping nickel from steel can be made with:

Sulfuric acid	2 gals.
Glycerine	2 oz.
Water	1 qt.

The authors have prepared a correlated abstract of information in the patent and technical literature on the uses of glycerine in metal treatment and processing. The uses of glycerine in plating solutions, electrochemical processes, soldering and hot galvanizing fluxes, quenching solutions, polishes and rust removers are described.—Ed.

This solution is used at room temperature, with a reverse current of six volts using lead cathodes. According to Hogaboom<sup>1</sup>, the rate of stripping will be increased by adding more water, but this will also increase the tendency to pit.

Cadmium plating solutions may similarly employ glycerine. The following formula is a case in point:

## Parts by Weight

Cadmium hydroxide	48.
Sodium sulfate	60.
Sodium cyanide	120.
Glycerine	12.
Nickel sulfate	1.5
Water	1000.

According to a very recent foreign patent<sup>2</sup>, glycerine is employed in solutions used for the electrodeposition of tungsten alloys. By the process advocated, lustrous tungsten-iron alloys are claimed to be obtained by electrolyzing a solution containing:

Sodium tungstate	400 gm.
Sodium pyrophosphate (dibasic)	400 "
Potassium chloride	100 "
Ammonium fluoride	40 "
Potassium ferrocyanide	2 "
Potassium hydroxide	100 "
Water	600 cc.
Alcohol	80 "
Glycerine	80 "

Although electrolysis may be effected at temperatures ranging from 40° to 100° C., 80° C. is preferable; a current density of 0.12 ampere per square centimeter is cited as best, but a range of 0.01 to 1 is given by the inventor. The alloy, after deposition on a metal surface, may be heated to 1000°-1200° C. or more to cause it to diffuse into the surface.

Electrical treatments of aluminum surfaces find frequent recourse to glycerine in the essential solutions. According to one patent<sup>3</sup>, a protecting layer is formed anodically on aluminum, in a bath containing sulfuric acid. Glycerine is added to the bath as a retarding agent. Aluminum and its alloys can be coated by anodic treat-

ment in an alkali metal hydroxide solution such as the following<sup>4</sup>:

Sodium hydroxide (98%) .....	20 gm.
Water .....	1 liter
Glycerine .....	150 cc.

The bath is operated at 10-15 volts, with a current density of 18-24 amperes per sq. ft. at 15°-25° C.

Oxide layers on aluminum can be similarly formed by anodic treatment<sup>5</sup> in a glycerine solution containing boric acid or some specified organic acid. Here, the bath is maintained at 120°-140° C. and the current density is such that the anode attains a temperature of about 200° C.

During investigations on optimum conditions for electrolytically obtaining continuous coatings of lead peroxide on copper, brass and iron to protect them against corrosion and improve their appearance, foreign investigators found that glycerine was one of the substances, which when added to the essential baths, results in tenacious elastic coatings which filled all the pits and pores of these metallic surfaces<sup>6</sup>. Glycerine also enters into other electrical methods for treating iron. Thus, by one process<sup>7</sup>, an iron object to be plated with any one of such metals as chromium, nickel, tin, lead, gold, silver, copper, bronze or cobalt is first dipped in a fused mixture of zinc 60, tin 20, and lead 40 per cent. The surface is amalgamated by dipping into a mercury salt solution containing glycerine. Electroplating is then effected by the ordinary methods.

Quite recently, a method has been devised for preparing iron powder in an electrolytic cell, from ferrous sulfate solutions which also contain glycerine as an essential ingredient.<sup>8</sup> In an older process, difficultly soluble basic metal compounds, such as lead carbonate, can be prepared by adding an organic catalyst such as glycerine to the electrolyte. This forms soluble intermediate compounds with the metal at the anode and causes precipitation of the basic metallic compounds when the concentration of the ions causes reformation of the organic catalyst.<sup>9</sup>

It might also be mentioned that glycerine is used as a plasticizer in the compounding or application of special electroplating preparations, such as resists, which are employed to control or limit the areas to be plated.

#### Use of Glycerine in Fluxes

That glycerine is a standard flux conditioner in the process of hot galvanizing of iron is well known<sup>10</sup>. Such fluxes clean the metal so that the zinc will readily adhere to it and also prevent the zinc from vaporizing. Writing on the use of glycerine in this connection, Imhoff<sup>11</sup> points out that the purpose of a flux conditioner is to make the flux light and puffy so as to avoid spattering and explosions. Says this authority, "From a practical standpoint, at least so far as the galvanizer is concerned, the important features in the chemistry of using glycerine as a flux conditioner are that the glycerine provides a medium for supplying and holding water in the flux. It also provides the fluidity necessary in a good working flux so that it can slip off the work easily, and not burn on to it, as a dry cakey flux usually does." Since glycerine fluxes are much heavier than such compounds made

up with other conditioners, they are excellent for use in galvanizing heavy work such as range boilers and tanks. A glycerine flux tends to float the boilers and keep them out of the molten metal until they are both heated and dried, ready for submersion.

For similar reasons, glycerine is a frequent ingredient of soldering fluids. A recent article on soldering of stainless steel recommends the addition of one teaspoonful of glycerine to each cup of the commercial stainless soldering flux being used. This, it is stated, will change the surface tension of the flux to enable it to wet the surface thoroughly and assist in completing the solder joint in the regular way<sup>12</sup>.

Glycerine, however, has long been listed as a soldering-fluid ingredient as shown by the following typical formulae:

Lactic acid .....	1 part
Glycerine .....	1 "
Water .....	8 parts

A soldering solution which is said to be satisfactory for copper, brass, steel, terne plate, tinned steel, monel metal and the like, consists of<sup>13</sup>:

Zinc chloride .....	15
Alcohol .....	25
Water .....	60

According to a British patent<sup>14</sup>, soldering fluxes can be made by mixing together phosphoric acid, a mixture of powdered ammonium chloride and glycerine and rosin.

#### Quenching Media

Glycerine has been advocated for use as a quenching medium for steel. As is well known, the range of quenching power between water and oil, the fluids most used, is exceedingly wide. It is the view of workers in this field of metallurgy that almost any desired range of cooling rate between those of oil and water can be attained by the use of glycerine-water solutions of various concentrations. Darke and Lewis<sup>15</sup> point out that the physical characteristics of glycerine make it a very acceptable quenching medium. It is not chemically active under the conditions of use suggested and furthermore, being readily soluble, it is easily removed from the surface of the treated steel by rinsing with water. Scott<sup>16</sup>, who has carried out extensive researches on this subject, has shown that glycerine-water solutions are effective steel-quenching agents and have distinctive and favorable characteristics when compared with those of oil and water.

Various standard methods now employ glycerine as a major ingredient of quenching liquids. In one case<sup>17</sup>, it is advocated that for a hard temper, 1/4 to 4% of potassium or manganese sulfate be added to the heated glycerine, and for a soft temper, 1-10% of manganese chloride or 1-4% of potassium chloride be added. The temperature of the tempering bath is varied according to the results desired. In another instance, when it is desired to soften steel, the metal is heated to redness and immersed in the following liquid:

Ammonium chloride .....	1 gm.
Salt .....	1 "
Glycerine .....	80 cc.
Water .....	100 "

Glycerine may also be used as a quenching medium for aluminum alloys. According to a patented process<sup>18</sup>,



aluminum alloy articles may be hardened from a temperature of 480°-540° C. by quenching in glycerine maintained at a temperature of from 110° to 180° C.

### Glycerine in Synthetic Resins

While it is not necessary to go too deeply into a discussion of these materials, one cannot consider the role of glycerine with metals without some mention of the highly important glycerine derivatives, the glycerine-phthalate or alkyd resins. These glycerine-containing resins have found widespread use in the formulation of protective coatings for all kinds of metals. By the use of various modifying agents such as oils, fatty acids, fillers, pigments and the like, these resins can be adapted to an almost unlimited variety of needs. These glycerine derivatives, being compatible with nitrocellulose, are widely used in making strong resistant lacquers of many types that may be applied by spraying, brushing or dipping. They dry rapidly and set hard and strong. Certain of these alkyd resins are employed in making clear and strong lacquers where hardness, durability and resistance to discoloration are desired. Modern lacquer enamels for automobile finishings, for refrigerators and the like usually contain substantial proportions of the various glycerine-phthalate type resins. Further discussion concerning these glycerine derivatives in protective coatings for metals is hardly necessary since the literature is replete with references to their use.<sup>19 20</sup>

The applicability of these resins is not limited, however, to their use in protective coatings. Alkyd resins also find use as binders for foundry sand.<sup>21</sup> According to the studies of Barrington<sup>22</sup>, alkyd (glyptal) resins, used in the manufacture of baked foundry cores, not only possess all of the desirable qualities necessary for such products, but in addition, have the property of vaporizing under high temperatures instead of charring or clinkering to form a hard mass after the casting has been made.

### Metal Polishes

Metal polishes of all types employ the diverse characteristics inherent in glycerine. In some cases one property is employed; in others, a combination of these qualities is utilized. Typical metal polishes are given below. The following aluminum polish, because of its sulfocyanide content, is suitable for industrial use only, where cognizance is taken of the poisonous character:

	Parts by Weight
Whiting	75
Fine, yellow tripoli	20
Sodium bicarbonate	3
Potassium sulfocyanide	2
Glycerine (25% aqueous) solution sufficient to form a paste.	

The gold polish following, though patented, is typical of similar preparations:

	Parts by Weight
Soap	20-25
Coconut oil	1
Precipitated chalk	25
Kieselguhr	8
Glycerine	40-45
Limonene	1

Silver polishing cloths similarly contain glycerine, as do impregnated cloths for general metal cleaning and polishing<sup>23</sup>.

### Rust Removers

Rust preventing or removing products employ glycerine and its derivatives, the glycerophosphates. Mason<sup>24</sup> recently presented the following paste, which when applied to surfaces, even those not ordinarily accessible, and allowed to remain on, in a warm place, for fifteen to twenty minutes, serves to remove all rust when washed off with water:

Oxalic acid	20
Phosphoric acid	20
Glycerine	10
Ground silica	50

Solutions of metal glycerophosphates are likewise advocated for preventing or removing rust from iron<sup>25</sup>.

Space prohibits detailed discussion of the many other uses of glycerine in connection with the treatment of metals. Mention only can be made of special glycerine-containing lubricants<sup>26</sup>, special adhesives for uniting woods, cardboard, paper, cotton fabric and the like to metals<sup>27</sup>, or for making compound panels<sup>28</sup>, or for making laminations of wood and sheet metals<sup>29</sup>. Mention might also be made of the use of glycerine in making fine edged blades, tools and the like<sup>30</sup>, and this fluid's employment in the preparation of metals for use in batteries or accumulators<sup>31</sup>. Quite recently glycerine has been advocated as an essential ingredient of materials and methods for uniting metals to ceramics<sup>32</sup>.

Any number of similar glycerine applications could also be cited.

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(Concluded on page 83)

# Plating on Baby Shoes

By Andrew V. Re

The author describes a method which he has used for plating on baby shoes, leather and other non-conducting surfaces. Information regarding cleaning, preparation of the surface to make it conductive and plating solutions is given.—Ed.

The process which is described below is satisfactory for plating on baby shoes or any leather, and adherent deposits of nickel, copper, gold, silver, etc. can be obtained.

## Cleaning

The first operation is careful cleaning of the surface by scrubbing with a mild cleaning solution to remove oils, etc. Fair success has been obtained with the following alkaline solution, operated from 90° to 95° F.

Borax— $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	3 ozs.
Sodium carbonate— $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	1 oz.
Caustic soda— $\text{NaOH}$	$\frac{1}{8}$ "
Black whale oil soap	$\frac{1}{8}$ "
Water	1 gal.

The leather should be well scrubbed, using a tampico scrub-brush with a long handle, and the leather should be wired or racked before cleaning, so that direct handling of the work can be subsequently avoided. After cleaning, the leather should be rinsed thoroughly with warm water.

## Making Shoes Conductive

The shoes are then placed under cover to dry to prevent dust and dirt, etc., from settling upon them. After the shoes or leather have been thoroughly dried, they are coated uniformly with orange shellac. The shellac is dissolved in alcohol and must be free from lumps or flakes, as otherwise rough deposits may be formed. The shellac may be applied by either brushing or spraying, and it is much better to apply two or three thin coats of shellac than to attempt to apply a heavy coating in one operation, inasmuch as a heavy coating may stick and form blisters or cracks. The purpose of the shellac is to make the leather water-proof.

Other materials, such as black asphalt varnish or other air drying varnishes, can be used with satisfaction. When the last coating of shellac is just a little tacky, copper or bronze powder is sprayed or brushed on the shellac. If the shellac has dried too much, the copper powder



Andrew V. Re

will, of course, not adhere. The powder is mixed with 1 part of lacquer and 4 parts of thinner, and clean copper powder should be used, inasmuch as normal powders for spraying may be coated with a fine greasy film which makes the particles relatively non-conductive.

## Plating

After the leather has been sprayed or brushed with a coat of powder, it is allowed to thoroughly dry, and after drying is plated in an acid copper solution, the formula for which follows:

Copper sulphate— $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	1 3/4 lbs.
Aluminum sulphate— $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$	1 oz.
Sulphuric acid— $\text{H}_2\text{SO}_4$	4 ozs.
Gelatin (transparent)	1/64 oz.
Water	1 gal.

Use soft sheet copper as anodes with about 2 volts.

Sometimes it is advisable to immerse the leather after it has been treated with bronze powder and thoroughly dried, into a weak silver cyanide solution, which gives a white tone to the bronze powder by displacement of silver from the solution. The white color imparted to the surface will enable more ready perception of the rate of deposition of coating and the degree of uniformity.



*Baby shoes which have been metallized by spraying with a lead-tin alloy. This sprayed metal coating can be used as a base for subsequent electroplating.*

Another acid copper solution, which works very nicely, is as follows:

Copper sulphate— $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .....	1 $\frac{3}{4}$ lbs.
Sulphuric acid— $\text{H}_2\text{SO}_4$ .....	4 ozs.
Dextrine (yellow) .....	$\frac{1}{4}$ oz.
Water .....	1 gal.
Temperature .....	80°F.

Volts: about 1 to 2, and the current density must be limited so as to avoid burning inasmuch as burned deposits will tend to flake or peel, due to stresses developed. A very slight air agitation of the copper solution is advisable to obviate burning.

The shoes should be wired before plating with soft copper making several points of contact and the copper plating should proceed for several hours to build up a coating with sufficient strength per se. After the shoes have been copper plated, they are removed from the solution, thoroughly rinsed, scratch-brushed or buffed to a luster. They are then cleaned and can be either oxidized or plated with such metals as nickel, silver or gold.

The method herewith described will also be found useful for plating on wood, plaster, roses, frogs, etc., except that better success is obtained with different cop-

per solutions. For example, for roses the following copper solution will work satisfactorily:

Copper sulphate— $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .....	24 ozs.
Aluminum sulphate— $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ .....	2 "
Corn syrup .....	$\frac{1}{8}$ oz.
Water .....	1 gal.

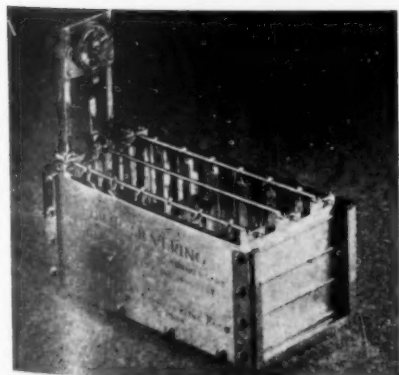
For making the shellac, a solution of methyl alcohol may be used, which is somewhat faster drying than ethyl or grain alcohol. The flowers should be dipped into the shellac solution and shaken well so as not to allow the shellac to penetrate too far into the flower. Hence, the objects to be plated must be as solid as possible and for fruit, not too ripe; preferably a little green, inasmuch as they are much firmer when green than when ripe.

The adherence of the plated coating to the leather has been frequently tested by making a sharp bend or twist in the plated material without in any way rupturing the union between the leather and the plated coating.

Various two-tone effects can, of course, be produced, such as brown and nickel, or silver and gold.

The plating of baby shoes requires considerable time and patience before the technique is mastered. However, it can be done.

### Award to Philip Sievering, Sr.



*At the left is shown a miniature gold plated plating outfit presented to Philip Sievering Sr. by the Masters' Electroplating Association.*

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# Repair Welding, Brazing and Soldering of Light Metal Castings

By Edmund R. Thews

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Berlin, Germany*

This very informative article was prepared for Metal Industry some months before the war started. Mr. Thews is a consulting metallurgist of international reputation. Welding, brazing and soldering techniques are described in detail as well as alloys and fluxes used for these purposes.—Ed.

## Introduction

It is possible by suitable methods of welding, brazing and soldering to repair many aluminum alloy castings to such an extent as to correct the great majority of all casting and finishing faults, the only factor limiting the range of utilization of this process usually being the relation of the cost of this process (equipment, gas, labor, etc.) to the respective value of the repaired casting. It is more economic sometimes to remelt a casting rather than spend good money on repairs, particularly if these castings are relatively small.

The selection of the process employed depends on a number of factors such as the mechanical properties of the castings, type of application, etc., contributory factors being the modes of finishing treatments (painting, varnishing, artificial oxidation, etc.).

The difference between repairing by welding, brazing and soldering of light metal castings as recognized in this article are as follows:

*Welding* can be effected by a number of processes depending on the type of repairs required:

(1) Fusion welding, in which both the welding and welding metal are fused, and since the soundness of the welds depends chiefly on the suitable and homogeneous composition of the weld sections, the welding rods used must be of the same composition as the castings themselves.

(1a) Filling-up welding, in which crevices, holes, recesses, etc. are filled up with metal of suitable but not necessarily identical composition, depending on the future application of the casting and on the position of the filled-up gap within the parts in question.

(2) Hammer or pressure welding, in which two suitably heated parts of the light metal are united by blows or pressure, depending on the technical properties of the casting alloys and on the welding equipment and conditions available.

(3) Light metal castings can also be repaired by spraying by means of suitably regulated spraying guns. Welding temperatures for the first three processes mentioned range between 1200° and 1400° F.

*Brazing* is effected with the aid of brazing alloys having melting temperatures lower than that of the light alloys but higher than those of solders. Brazing temperatures range between 750° and 1100° F.

*Soldering* is employed where mechanical properties, etc. are not necessarily of the highest, where the lightness of the castings are not important and where the speed of the repairing process is a governing factor. The solders employed for this purpose range between solders rich in tin or zinc respectively, depending on conditions. The soldering temperatures range from 400° to 750° F.

## Repair Welding

### *Fusion Welding.*

Repair welding of light metal castings should not be effected to cover up every fault regardless of results, but only where the fusion welding or other processes ensure the full recovery and retention of the original technical properties of the castings involved. If the faults to be eliminated consist of local blisters or sand inclusions or of dross accumulations penetrating to an unimportant extent into the casting, coarse or light pipes, pores, cracks, small crevices, etc., welding (or, alternatively, brazing or soldering) can be carried out. Wrongly placed or dimensioned bore holes, eyes, ears, local machining or finishing faults may also be repaired by filling-up welding, brazing or soldering, while cracks or fractures occurring during finishing operations can frequently be repaired so as to recover or retain the full usefulness of the castings.

However, crevices or other faults extending over large or important sections of the castings, large sand or dross inclusions, faults due to the collapsing of cores or mold sections and coarsely deformed parts of castings should

not be repaired. If repairs of this type are carried out with due consideration of these limitations and in accordance with best welding practice, the castings produced are practically as good as ordinary faultless products.

Attention should, in this connection, be called to the fact that in many instances welding of castings forms part of the normal process of production especially where the castings are too complicated to be cast in single units. Indeed, there can be no doubt that, if in such instances it would be much more disadvantageous with regard to the technical properties of these castings to produce them whole in spite of the considerable and varying tensions and stresses unavoidable in such instances, instead of dividing the units to be produced into two or three part castings and uniting them by suitable welding operations. It is obvious, of course, that in the case of such castings, the V-ing and other preparatory operations usually accompanying the welding processes are already provided for in the moulds, but this additional work necessitated in repair welding certainly is not sufficiently difficult or tedious for an experienced hand to detract from the value of repair welding.

The strength and elongation properties of the weld sections of light metal castings are easily as satisfactory as the corresponding properties of the castings themselves if the composition of the rod metal and fluxes is suitable and if the preparatory work and the welding operation itself have been carried out with due care. Indeed, it is frequently observed in tensile tests that cracking does not occur in the welded section but at some point outside. This is particularly true of castings made from unrefined aluminum-copper alloys of the "American" type and aluminum-zinc alloys of the "German" type. This is due to the fact that the welded section consists of highly refined alloys of the type selected due to the fluxes employed; there are no impurities in the crystal structure and the metal therefore exhibits correspondingly improved mechanical properties. Many of the complaints concerning the deterioration of castings due to repair welding have been found to be due to the use of unsuitable rod metal. It is absolutely necessary for purpose of strength and corrosion resistance to use a metal composed exactly like the casting alloy. Even if the puddling operations connected with the welding operations induce a certain amount of intermixing, this does not suffice to ensure the degree of homogeneity required. Pure aluminum rods should, for this reason, never be used for repairing alloy castings, while the application of entirely different alloys is bound to cause serious difficulties later on.

The corrosion resistance of suitably welded light metal castings is not impaired in any way. If the precautions above mentioned are observed, there is practically no difference of potential between the weld section and the neighboring metal, although such a difference may be introduced by subsequent cold hammering of the weld which is frequently effected in order to improve the strength values of the welded sections. Color and temperature resistance also are entirely like the corresponding properties of the casting proper.

**Welding Rods.** The only general rule applying to the choice of welding rods for the repair welding of light metal castings is that their composition should correspond

as much as possible to that of the castings welded. Wherever possible, the rods should be cut from castings poured from the same heat, although it is not difficult, of course, to prepare a special heat of practically the same composition. Wherever it is doubtful whether exact identity of composition can be attained by this means, a few per cent of silicon should be added which is bound to improve all the technical properties of the castings with the exception of the corrosion resistance. This applies especially to straight aluminum castings which are very much improved mechanically if the welding rods contain besides pure aluminum, 5 per cent of silicon. The future application of the castings governs the question of whether such additions are possible in view of eventual contact of the castings with water, moisture or other corrosion agents.

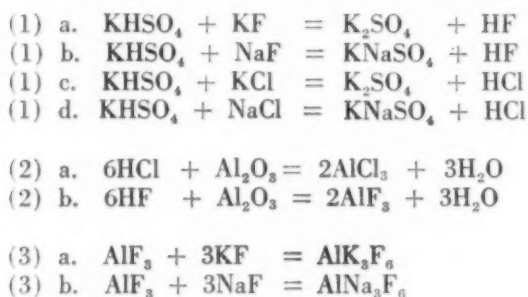
Another point to be considered in this connection is the thermal changes accompanied by expansions and contractions of the castings, or the welding sections concerned, which may induce unfavorable stresses within the weld. (This point will be taken up in more detail below.) Where maximum strength and elongation of the weld sections form a chief requirement and where corrosion stresses need not be considered because of favorable external conditions, it is frequently attempted to use filling rod material possessing a wider range of solidification and relatively low solidification contraction, so that at the end of the welding operation (when larger castings still tend to expand while the considerably hotter weld section commences to cool and contract), this dangerous difference does not prevail after the weld metal has come to a set. Comparatively low melting points also tend to diminish this danger. It will be shown, however, that this difficulty can be overcome by proper manipulation and that the unquestionable advantages offered by homogeneous composition of the structure can be maintained in spite of the disadvantageous thermal properties of the aluminum alloys.

**Fluxes.** Since during the welding of aluminium and its alloys, oxidation cannot be prevented by any practical means, and since the oxide formed would deteriorate the mechanical and chemical (corrosive) properties of the weld section, suitable solvent fluxes must be applied. Apart from their solvent action on aluminum oxide, these fluxes or flux mixtures must be composed so as to melt at a certain temperature just below the fusion temperature of the alloys welded in order to avoid premature freezing of the flux-mixtures on one hand and too low a viscosity on the other. It should be remembered in this connection that the melting or freezing points of these flux mixtures are considerably influenced by the aluminum oxide contents dissolved by them.

The effective constituents of the flux mixtures generally used are the chlorides and fluorides of sodium, lithium, potassium, magnesium, calcium, barium and zinc, while auxiliary constituents are sodium and potassium bisulphate, sodium tetraborate (borax), cryolite and sodium and potassium carbonate. Small percentages of bromides and phosphates as well as the chloride, fluoride and sulphate of aluminum are also found in mixtures of this type, especially in the proprietary fluxes offered on the market. A study of this list indicates that the mixtures contain high and low melting constituents and it is obvious, therefore, that perfect mixing is one of the

chief requirements to be made on these materials in order to avoid leaving solid chemical impurities within the weld, causing strong corrosion effects as soon as the castings are taken into operation. The fluxing action of the above mixtures are best indicated by the following reactions of some of the constituents mentioned:

#### Reactions of Flux Constituents



It is thus evident that some of the constituents of the flux mixtures react chemically with the others, forming compounds which, on their part, react directly with the impurities to be removed, chiefly aluminum oxide. Most active in this respect are the alkali bisulphates which liberate the corresponding halogen acids from the chlorides and fluorides. These halogen acids (hydrochloric and hydrofluoric acids) then dissolve aluminium oxide, forming volatile aluminum halogenides as shown by the formulas (2) a and b. Part of the aluminum fluoride produced according to equation (2)b reacts with potassium and sodium fluoride, forming complex compounds of the cryolite type which possess a very pronounced solvent action on aluminum oxide [equations (3)a and b]. The aluminum halogenides represent the volatile, or gaseous, refining substances characterizing these fluxes. The ideal melting, or freezing, temperature of these fluxes should be about 75 to 85° Fahrenheit below the corresponding temperatures of the light metal alloys welded.

The difficulties sometimes encountered in the use of these fluxes are due:

- (1) To incorrect or insufficient mixing of the ingredients. This pertains particularly to the fluxes applied in a paste-like state which should be carefully mixed with a rod or spatula directly previous to application.
- (2) To insufficient protection of the strongly hygroscopic flux mixtures against atmospheric moisture. If moisture is absorbed by the flux mixtures, they lose the definite proportions of the water of crystallization required for maximum fluxing action. The fluxes should therefore be kept in air-tight containers and should not be made up into pastes until directly previous to application.

#### Paste Fluxes

The flux pastes consist of 2 parts of solid flux and 1 part of alcohol (also hygroscopic) or water. It is applied by brush, welding rod, or wire. The rod should not be dipped into the dry flux in a red hot condition as is frequently suggested and practiced in steel welding. This difference is due to the low melting temperature of the light metal welding rods which does not permit the

heating to sufficiently high temperatures to fuse the flux mixtures and to apply them in their correct compositions. Apart from the fact that comparatively small quantities of the dry mixture will remain stuck to the hot rod, the difficulty arises that some of the hard melting components will not stick at all, so that the first extractions of flux will exhibit comparatively low fusion temperatures, those of the latter extractions being excessively high. Fluxing pastes always are the most efficient, especially for the repair welding of light metal castings, while the most satisfactory of all are the flux-filled welding rods, which if produced correctly, always ensure perfect mixture of the flux constituents.

#### Welding Procedures

Repair welding of light metal castings may logically be subdivided into four separate steps: (1) Cleaning and preparing the section to be welded, (2) Preheating of the entire casting or, eventually, the section to be welded, (3) The welding operation proper, (4) The finishing treatment of the welded castings.

*Cleaning and preparation* of the light metal castings for repair welding consist chiefly of the cutting-out of the faulty sections so as to offer clean metallic surfaces. This can be carried out by cutting, milling, planing, filing, boring or by any other suitable means depending on the shape and location of the fault. It is not necessary to Vee out the sections in question. Indeed, it is frequently advisable to undercut the recesses so as to improve the anchorage of the filled-in material when closing up holes and crevices. The governing requirement is to obtain clean metallic surfaces.

Some repair welders prefer to do this part of the work during the welding operation, i.e. by scratching out the impurities after heating the surrounding metal to the fusion point. This practice is not to be recommended, however, since excessive amounts of impurities are thus introduced into the weld section. Cleaning of the weld should always be carried out previous to preheating, the most satisfactory and efficient tool for this purpose in the writer's experience being an electrically driven grinding wheel arrangement for manual operation with a set of suitable wheel shapes including thin round-headed or pointed (bevelled) grinding tools operated with the axis of rotation vertical toward the grinding face or point.

The section thus prepared by mechanical cutting treatment should now be etched by 30 to 60 seconds exposure to a 10 per cent caustic soda solution. Apart from the additional cleaning effect of this treatment, it serves to roughen the surface so as to render it much more adaptable to the welding processes in question. The caustic solution is washed off, the section moistened with a 2 or 3 per cent solution of nitric acid (to neutralize the caustic) and the remaining acid traces removed with hot water which is then wiped off. Perfect drying by hot air, etc. is not necessary if the casting is subjected at once to the preheating process, which always is the most satisfactory procedure.

*Preheating of Castings.* Many old welders pride themselves on their skill in repair welding castings without preheating. However, this pride is false in more than one respect. Anybody can weld a casting without preheating, the question is whether this weld will satisfy in the long run.

(Continued in March issue)



# Drying Methods in Electroplating

By Philip J. LoPresti

Hickok Mfg. Company, Rochester, N. Y.

The author presents suggestions for standard procedures in drying electroplated work. The influences of hardness in water on drying and material costs for cleaning, are considered.—Ed.

The usual method of drying electroplated work is as follows:

- (a) Rinse in cold water
- (b) Rinse in boiling water
- (c) Dry in sawdust, hot oven, or airblast.

This method is used in drying work from still, semi-automatic, full automatic and barrel plating solutions. The results in drying are varied and frequently trouble is encountered in not drying thoroughly and also in staining plated material.

The purpose of this paper is to standardize the drying process, adopt the correct method for the class of work and to arrive at an efficient method in which the results can be controlled.

In standardizing the drying process, the various materials such as water, steam, air, sawdust, and mechanical equipment used, are analyzed as follows:

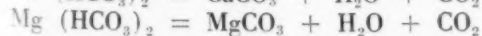
## A. Materials.

### 1. Water.

(a) Water is defined as being soft or hard. The only common soft waters are: rain and distilled water. All natural water supplies are hard water. The hardness is formed by solution of minerals in the course of travel of a stream and further solution of minerals in the place of storage. Our water supply can be called a very dilute solution of minerals. The concentration of these minerals of water hardness depends on the locality of the water and the contact it has had in reaching your supply. The hardness of the same water supply can vary during the course of a year.

Hard waters are divided into two classes:

(1) Temporary hardness (can be removed economically). This hardness consists usually of calcium and magnesium bicarbonates and on boiling are converted to precipitates as follows:



(2) Permanent hardness. (Some types of hardness too costly to remove.) This hardness consists of a slight amount of soluble carbonates left in water after removing temporary hardness (about 0.013 grams/liter) and also non-decomposable soluble salts of calcium, magnesium, iron or other metals that can form insoluble soaps of fatty acids. In other words, temporary hardness can easily be removed from water while some types of hard water are too costly to soften.

B. The study of the water supply is very important in plating for the following reasons:

A soft water supply will reduce "water-breaks," the result of incomplete emulsification of "dirt," caused in the following way:

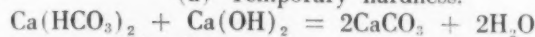
(1) Deposition of insoluble soap on work formed by chemical action between fatty acids of buffing compositions and calcium or magnesium salts in hard water.

(2) Deposition of insoluble soap left on work after using soaking soap or electrocleaner and rinsing in hard water. In other words, after using a good cleaner, a "water-break" can be caused after contact with hard water.

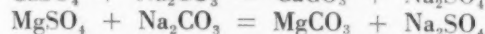
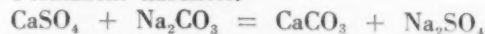
(3) A soft water supply will mean less cleaning compound used. The theory in cleaning is to emulsify oil, grease, or buffing composition on work. If a portion of the cleaner is spent in forming insoluble soaps in quantities relative to the amount of hardness of water used in cleaner, then the efficiency or cost of cleaner will be determined by the hardness of water or the amount of cleaner that is spent in emulsifying "dirt" and not in forming insoluble soaps.

C. Temporary and permanent hardness can be removed from water by treatment with the Lime-Soda Ash Method, having the following reactions:

(a) Temporary hardness.



(b) Permanent hardness.



Another method of removing temporary and permanent hardness is the Zeolite treatment. In this method, Zeolites, which are silicates of aluminum and alkali metals, precipitate the calcium and magnesium as Zeolates and corresponding soluble sodium sulphate is produced if



Philip J. LoPresti

## ANALYSIS OF VARIOUS WATER SUPPLIES

## MILLIGRAMS PER LITER, BY WEIGHT

	Lake Superior, Sault Ste. Marie, Mich.	Deschutes River, Moody, Oregon	Mississippi River, New Orleans, Louisiana	Green River, Green- river, Wyoming	Youghio- gheny River, McKees- port, Pa.	Bumpass, Hot Springs, Shasta County, Calif.
Na	3.2	6.7	13.	32.	8.0	16.
K		1.6			1.8	14.
Ca	13.	5.1	32.	41.	23.	8.9
Mg	3.1	1.6	8.4	13.	6.7	5.1
Fe	0.06	0.04	0.5	...	4.7	1.4
Al						5.3
H					0.5	0.37
NO <sub>3</sub>	0.50	0.22	2.5	0.12	1.1	trace
Cl	1.1	1.2	0.7	15.	4.5	trace
SO <sub>4</sub>	2.1	3.6	24.	81.	123.	141.
HCO <sub>3</sub>	56.	34.	111.	140.	0.0	0.0
TOTAL	79.1	54.1	201.1	322.1	173.3	192.1

hardness is a sulphate. Many advantages are claimed for the Zeolite treatment as follows:

(1) Zeolites produce water of "zero hardness."

(2) Zeolites can be used over again by recharging with salt water. In this treatment, the insoluble salts of calcium and magnesium are converted to soluble chlorides and are flushed out. The Zeolites can thus be used over again.

(3) The Zeolite method does not produce under-treated or over-treated water, as can happen in the lime-soda ash method.

## 2. Steam.

(a) In making steam, nearly every boiler foams, due to concentration of salines in boiler. This contamination occurs in nearly all steam supplies. The harmful effect is that these compounds clog steam traps and due to back pressure in coils, will cause a leak in weakest part of coil. This compound can be very harmful to bright nickel solutions if it contains lime.

(b) Live steam should not be used in hot water rinses because the salts in steam will contaminate water. With sufficient concentration, the contaminated water will precipitate salts on work being dried.

## MAXIMUM, MINIMUM, AND MEAN VALUES FOR SPECIFIED MINERAL CONSTITUENTS BEFORE AND AFTER SOFTENING

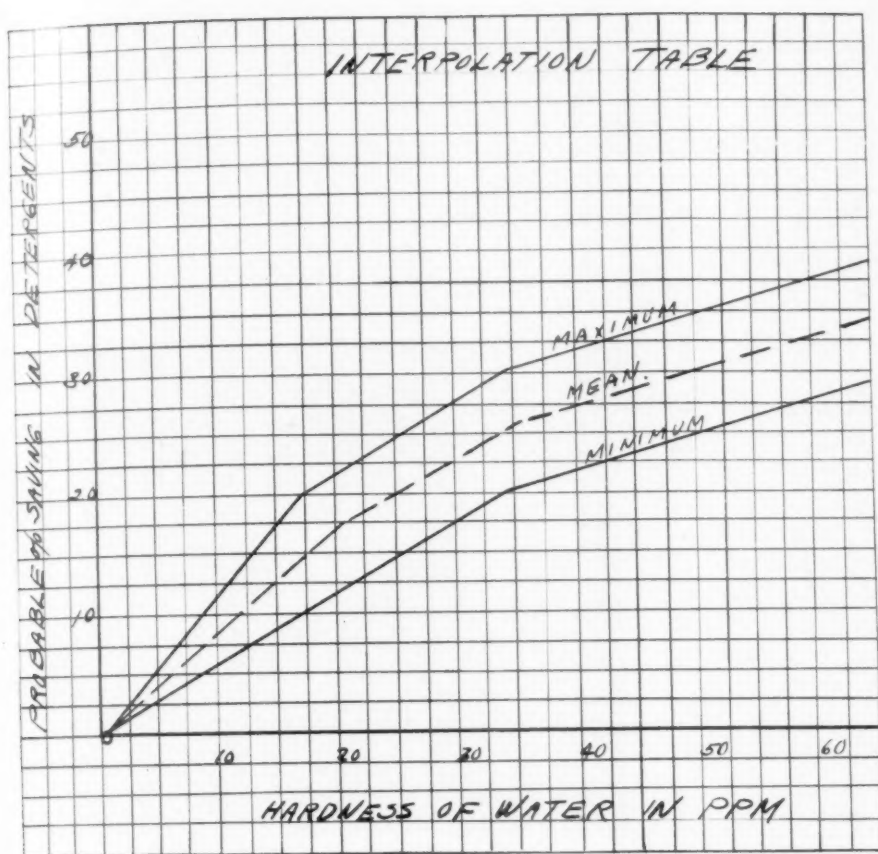
(Parts per million)

Constitu- ents	Maximum		Minimum		Mean		Per Cent Reduc- tion
	Before	After	Before	After	Before	After	
Suspended matter	959	40	0	0	41	1.1	98
Colloidal matter	74	..	5.8	2.1	26	18	31
Silica (SiO <sub>2</sub> )	68	58	2.7	2.1	22	16	27
Iron oxide & alumina (Fe <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> )	40	8.9	trace	0	4.8	2.1	56
Free carbon dioxide (CO <sub>2</sub> )	238	0	1.7	0	49	0	100
Calcium (Ca)	581	21	12	5.1	103	12	88
Magnesium (Mg)	156	27	1.3	0.6	28	5.2	82

## ANALYSES OF WATERS AND RESULTS OF FORMULAS

(Parts per million)

	WEIGHTS					REACTING VALUES				
	A	B	C	D	E	A	B	C	D	E
1. Suspended matter	30.00	118.00	00.00	14.00	0.00					
2. Colloidal matter	3.07	9.36	11.23	13.60	10.80					
Silica (SiO <sub>2</sub> )	3.00	9.80	11.00	11.00	6.50					
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	0.07	0.06	0.23	2.60	4.30					
Alumina (Al <sub>2</sub> O <sub>3</sub> )		2.50								
3. Dissolved gas:										
Carbon dioxide (CO <sub>2</sub> )	10.00	0.00	7.50		122.00					
4. Dissolved radicals:										
Calcium (Ca)	11.00	10.00	64.00	8.30	28.00	0.55	0.80	3.19	0.41	1.40
Magnesium (Mg)	2.80	4.20	12.00	1.80	12.00	0.23	0.34	0.98	0.15	0.98
Sodium (Na)	4.60	7.90	48.00	9.00	386.00	0.20	0.34	2.08	0.39	16.76
Potassium (K)	1.10			3.00	7.00	0.03			0.08	0.18
Hydrogen (H)	0.00	0.08	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
Sum basic radicals						1.01	1.56	6.25	1.03	19.32
Carbonate (CO <sub>3</sub> )	0.00	0.00	trace	0.00	238.00	0.00	0.00	0.00	0.00	7.93
Bicarbonate (HCO <sub>3</sub> )	41.00	0.00	156.00	39.00	162.00	0.67	0.00	2.55	0.04	2.66
Sulphate (SO <sub>4</sub> )	6.80	76.00	51.00	5.60	145.00	0.14	1.58	1.06	0.12	3.02
Chlorine (Cl)	7.00	2.70	97.00	5.80	213.00	0.20	0.08	2.74	0.16	6.00
Nitrate (NO <sub>3</sub> )	0.00	1.20	0.40	trace		0.00	0.02	0.01	0.00	
Sum acid radicals						1.01	1.08	6.30	0.92	19.63



Curve showing relationship between probable saving in detergent against hardness of water.

(Courtesy Permutit Co., N. Y.)

### 3. Air.

The air compressor should draw clean filtered air. All air contains moisture and is condensed in compressor. Air is also contaminated with oil from compressor. It is a necessary practice to have the oil and water frequently blown off so that clean air is supplied.

### 4. Sawdust.

Cheap sawdust can be very expensive. Any sawdust available should not be used. Rock maple is preferred to any other wood, as it is hard, yet absorbent, neutral in tone and contains no free acid which might otherwise tarnish the work. It contains no free gums or resins. Being neutral, it is not liable to cause occupational disease as does boxwood, formerly employed for the purpose.

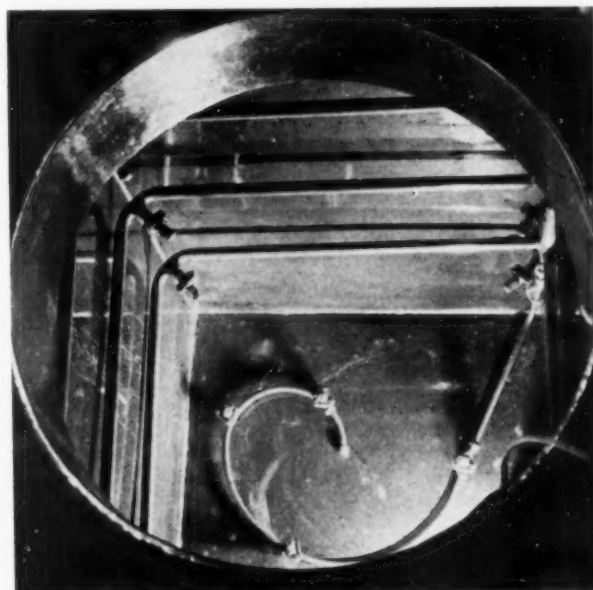
A new drying agent, which is finding widespread use because of its high absorbing power for water and low dust content, is a material made from corn cobs.

### 5. Mechanical Equipment.

(1) In drying work from still, semi-automatic and full



Hand-lever type of spray rinse tank for general and special production use.



Interior of spray rinse tank showing arrangement of nozzles.

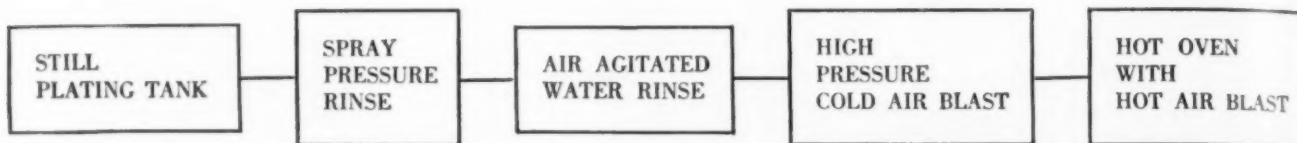
(Courtesy Storck Welding Co., Meriden, Conn.)

	A.	B.	C.	D.	E.
1. Soap cost (cents per 1000 gallons)	50.	72.	211.	39.	130.
2. Pounds, 90% limes to soften 1M gal.	0.35	0.11	1.01	0.21	2.39
3. Pounds, 95% soda ash to soften 1M gal.	0.05	0.57	0.75	0.00	0.00
4. Foaming coefficient, f	15.	21.	130.	30.	1057.
5. Coefficient of corrosion, c	-0.44	0.42	-1.58	-0.49	-9.69
C + 0.0503 Ca	0.11	1.23	1.63	-0.08	-8.28
6. Scale, Sc (pounds per 1000 gals.)	0.59	1.51	1.84	0.46	0.94
7. Hard scale, Hs (pounds per 1000 gals.)	0.12	0.56	0.85	0.12	0.22
8. Coefficient of scale hardness, h	0.20	0.37	0.46	0.25	0.23
9. Alkali coefficient, k	290.	440.	22.	280.	2.6



automatic solutions, a more efficient method than drying in hot sawdust should be used where possible. The most efficient method would be an entirely mechanical method. Naturally, the method can't be standard for all articles

This last mentioned method consists of an overhead monorail chain hoist system where the barrel is rinsed in water and then emptied in hopper of mechanical unit which can either use hot sawdust or hot air blast. This

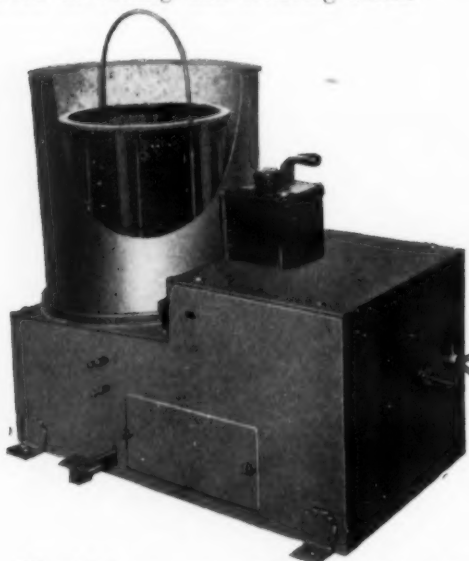


because the method must fit the work being dried. A suggested method is given above.

The spray rinse can be used effectively with the following advantages:

- (1) Makes it simple to reduce "drag-out" by having a solution that can be easily recovered.
- (2) It reduces water costs when foot pedals or automatic devices are used to turn water on and off.
- (3) It reduces contamination of water rinses, cyanide, acid and cleaning solutions by running "drag-out" from one solution to another. In this way, these solutions will last longer and reduce rejects and plating costs.

Air agitation in water rinses is recommended in helping to rinse work more thoroughly and reduce hand work in raising and lowering racks.



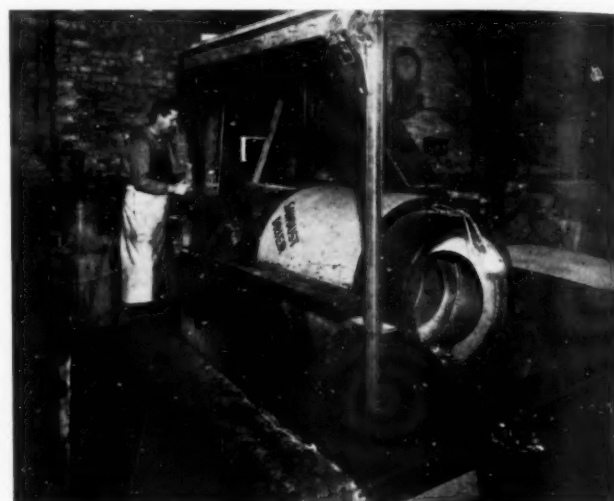
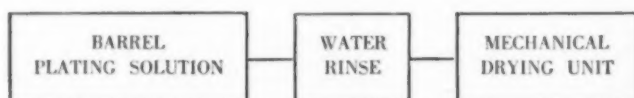
*Centrifugal Dryer*

(Courtesy Dellinger Mfg. Co., Lancaster, Pa.)

The high pressure cold air blast before drying in oven, removes water from work and this way minimizes water stains in drying.

Drying barrel plated work is done as follows:

- (a) Whirling work in centrifugal dryer having a hot air blast.
- (b) Drying with hot sawdust or corncob drying agent in hand sieve.
- (c) Drying with hot sawdust in rotating barrel and mechanically operated sieve.
- (d) Using the following method which is recommended where possible:



*Continuous sawdust drying unit.*

(Courtesy N. Ransohoff, Inc., Cincinnati, Ohio.)



*Charging end of a rinse and drying machine.*

(Courtesy N. Ransohoff, Inc., Cincinnati, Ohio.)

dryer operates automatically and work comes out clean and dry.

The setting of these standards in drying electroplated work is an example of what can be done to reduce costs and improve methods in electroplating.

#### *References and Acknowledgments*

Allen Rogers Industrial Chemistry  
Permutit Co., New York  
Lignum Products Co., Brooklyn, N. Y.  
N. Ransohoff, Cincinnati, Ohio  
Storts Welding Co., Meriden, Conn.  
Mahin "Quantitative Analysis"

# Dropping Tests for Measuring the Thickness of Zinc and Cadmium Coatings on Steel\*

By Dr. Abner Brenner

Chemist, National Bureau of Standards, Washington, D. C.

A study of various reagents for determining the thickness of zinc and cadmium coatings by dropping methods, is reported. The reagents investigated include ammonium nitrate, ammonium nitrate with potassium ferriocyanide and chromic acid. It is recommended that the chromic acid reagent be used for the dropping test instead of the ammonium nitrate reagent, and in any specifications based on these tests, a minus tolerance of 20% be allowed.

—Ed.

## I. Introduction

One of the present trends in the electroplating industry is the adoption of specifications requiring a certain minimum thickness of coating. If these specifications are to be observed, both the manufacturer and the purchaser must have reliable methods of measuring the thickness of coatings. In any testing work, not only the method of testing is important, but also the method of sampling. At the present time, it is customary to take one (or a few) samples out of a shipment and test them by relatively accurate methods. However, more information about the shipment could be obtained by testing a larger number of samples by a rapid, although less accurate, method.

A number of methods have been suggested for determining the thickness of zinc and cadmium coatings. Of these methods, the dropping test seemed most promising because it is easily performed by inexperienced persons and requires no expensive apparatus. The test was devised by Clarke<sup>1</sup> and modified by Hull and Strausser<sup>2</sup>, who substituted ammonium nitrate solutions for the iodine reagent used by Clarke. After the test had come into general use, it was reported that the end-points were unsatisfactory for some commercial materials. Therefore, it was considered advisable to study again the dropping test to improve the sharpness of the end-point and to determine

its accuracy on zinc and cadmium coatings from different sources.

Two types of dropping test reagents were used in this study: (1) The ammonium nitrate reagents recommended by Hull and Strausser, and (2) a new reagent developed in the course of this investigation, consisting of 200 g/l of chromic acid and 50 g/l of sulphuric acid. For purposes of comparison, measurements were also made with other methods of measuring thickness: the jet method<sup>3</sup>, the magnetic method<sup>4</sup> and the microscopic method.

## II. Apparatus

The original apparatus of Clarke<sup>3</sup> had two stop-cocks, one for adjusting the rate of flow of solution and the other for turning it on and off. The modified apparatus shown in Fig. 1 has a capillary tube B, for obtaining the desired rate of flow, which is 100 drops per minute. With a given size of capillary, the proper rate of flow can be obtained by adjusting the head of liquid. A satisfactory capillary is one with a bore of 0.025" and a length of 5.5 inches. It is connected to the tap-funnel by ordinary wide-bore glass tubing of sufficient length to give the required head of liquid. The tube A, inside of the tap-funnel, is moved up or down to make small adjustments in the head of liquid and, once set, serves to maintain a constant head. With this apparatus there is no difficulty in keeping the rate of dropping constant within  $\pm 3$  drops per minute.

The tip of the capillary is tapered, so that the volume of a drop is about 0.05 ml. The test specimen is inclined at an angle of about 45° to the horizontal. The tip of the capil-

lary should be about 0.4 inch above the specimen when the ammonium nitrate reagent is used, and 0.8 inch when the chromic acid reagent is used. However, the angle and distances are not critical. The chromic acid reagent attacks rubber, hence the rubber tubing must be replaced occasionally. Petroleum jelly should be used for lubri-



Dr. Abner Brenner

\*Reprinted from Proceedings of American Electroplaters' Society, 1939.

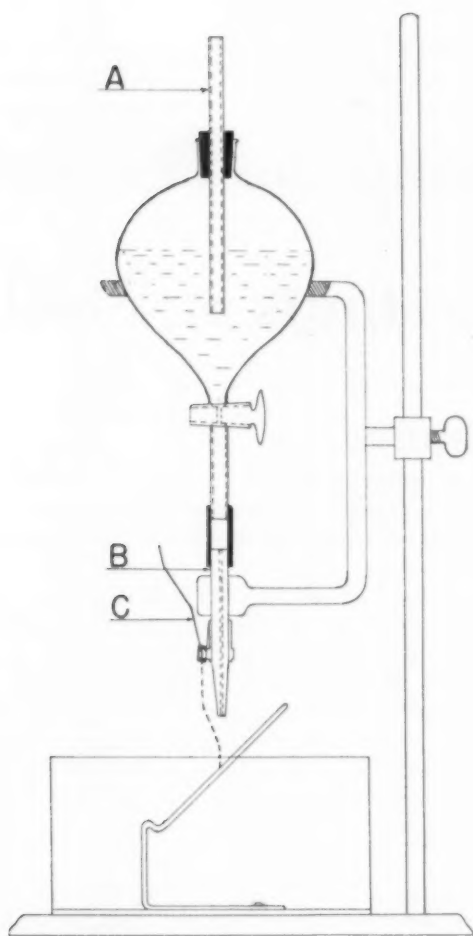


Fig. 1.—Dropping Test Apparatus.

- A. Glass tube for maintaining a constant head of liquid.  
 B. Capillary tube.  
 C. Device for adjusting the distance between the capillary tip and the specimen.

cating the stopcock.

The apparatus used for the jet method and the magnetic method are fully described in the above references.

### III. Procedure

The dropping test consists in running the reagent onto the surface to be tested until the coating is penetrated. The end-point consists in the exposure of the base metal, the color of which usually offers a good contrast to the surrounding area of etched coating. The time required for penetration is measured with a stop-watch. The thickness of coating, in hundred-thousandths inch, is obtained by multiplying the number of seconds by the appropriate thickness factor. The room temperature is also noted, as the value of the thickness factor depends on the temperature.

In studying the dropping test, the general plan of procedure was to first standardize the reagents (i.e. determine their thickness factors) with coatings of known uniform thickness plated on smooth steel. Then, using these standardizations (or thickness factors), measurements were made on commercial materials. The accuracy of these measurements was determined by comparison with a standard method of measuring thickness.

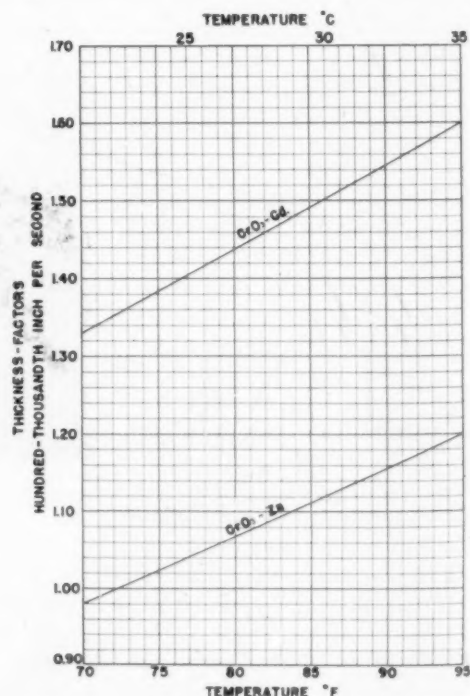
The antimony trichloride stripping method was taken as the standard method of determining thickness, with

which all other methods were compared. The reagent contains 20 gms. of antimony trioxide dissolved in 1 liter of concentrated hydrochloric acid.

The methods were compared by the following procedure: The specimen was weighed, one side protected with a "stop-off" lacquer, and the coating on the unprotected side was tested by a given method. The remainder of the coating on this side was dissolved in the antimony trichloride reagent. The average thickness of coating was calculated from the loss in weight of the specimen and the area and density of the coating.

The dropping test was standardized by testing coatings of uniform thickness on flat surfaces. These were obtained from different sources. The result of the standardization was expressed as a thickness factor, which was equal to the number of hundred-thousandths of an inch of coating dissolved per second. Hence, the thickness of an unknown coating is obtained by multiplying the number of seconds required for penetration, by the thickness factor. As the thickness factors vary with temperature, they were measured at two temperatures, 70° and 95°F. Intermediate values of the factor were obtained from a straight line relation. Figure II shows the variation with temperature of the thickness factors of the chromic acid reagent. The thickness factors of the chromic acid reagent are practically the same for the three types of zinc coatings,—electroplated, hot-dipped, and sherardized; therefore, the average values, represented by the straight line in Fig. II, can be used for any one of the three types of coating.

The composition of the reagents used and the summary of the results of the standardization of the dropping tests are given in Table I. The results of tests of commercial coatings by various methods are given in Table II. The commercial materials were mainly electrical fittings. The base metals were mild sheet steel, grey cast iron, and malleable cast iron, and were generally rough. The results of the measurements by the



Thickness factors for various temperatures.



**TABLE I.**  
**Compositions and Thickness Factors of Dropping Test Solutions**

Composition and Thickness Factors of Dipping Test Solutions												
Symbol	Coating Type	No. of Sources	Composition of Reagent						Thickness factors		% Av. deviation from mean	Max. % deviation from mean
			Oxidizing Agent		Acid							
			Formula	g/l	Formula	ml/l (conc. acid)	N in reagent	70°F. 21°C.	75°F. 35°C.			
N <sub>8</sub>	Zinc electro	4	NH <sub>4</sub> NO <sub>3</sub>	100	HNO <sub>3</sub>	55	0.85	1.03	1.06	± 6	+13	
N <sub>11</sub>	hot-dipped	6	NH <sub>4</sub> NO <sub>3</sub>	100	HCl	75	.85	.93	1.01	± 4	± 8	
N <sub>3</sub>	sherard.	3	NH <sub>4</sub> NO <sub>3</sub>	100	HCl	125	1.45	1.24	1.64	± 7	±17	
N <sub>ca</sub>	Cd electro	4	NH <sub>4</sub> NO <sub>3</sub>	110	HCl	10	.12	.95	1.30	±13	-25	
CrO <sub>3</sub>	Zn electro	4	CrO <sub>3</sub>	200	H <sub>2</sub> SO <sub>4</sub>	27	1.0	0.97	1.19	± 2	- 2	
CrO <sub>3</sub>	hot-dipped	6	CrO <sub>3</sub>	200	H <sub>2</sub> SO <sub>4</sub>	27	1.0	1.01	1.21	± 4	-10	
CrO <sub>3</sub>	sherard.	3	CrO <sub>3</sub>	200	H <sub>2</sub> SO <sub>4</sub>	27	1.0	.96	1.21	± 7	-14	
General Average (CrO <sub>3</sub> reagent)								.98	1.20	± 4	-14	
CrO <sub>3</sub>	Cd electro	4	CrO <sub>3</sub>	200	H <sub>2</sub> SO <sub>4</sub>	27	1.0	1.33	1.60	± 3	+ 5	

Solutions N<sub>8</sub>, N<sub>11</sub>, and N<sub>ca</sub> were developed by Hull and Strausser. Solution N<sub>3</sub> was developed by W. G. Schlecht of this laboratory.

dropping test are discussed first, and those obtained by the other methods are discussed in a later section.

#### IV. Dropping Tests

##### A. Electroplated Zinc Coatings:

The thickness factors for electroplated zinc coatings are given in Table I. The ammonium nitrate reagent, N<sub>8</sub>, has a thickness factor near unity, and a small temperature coefficient as reported by Hull and Strausser. The factor of the chromic acid reagent shows somewhat less variation with different types of zinc coatings than does that of the ammonium nitrate solution, but it has a temperature coefficient of about 1 per cent per degree F.

The results of measurements of commercially plated zinc coatings are shown in Table II. The ammonium nitrate reagent, N<sub>8</sub> does not give a satisfactory end-point on most zinc-mercury coatings, as the colors of the steel and of the etched zinc are similar. A modified reagent (N<sub>8</sub> + 3.0 g/l of potassium ferricyanide) suggested by Hull was also tried. After the underlying steel is exposed, the ferricyanide produces a blue color with iron

dissolved from the base metal. With this reagent, rather large positive errors were obtained, apparently because the appearance of the blue color is delayed. The chromic acid reagent gave satisfactory end-points with all zinc coatings including the zinc-mercury coatings. When the latter coatings were tested, a black color appeared just before the coating was penetrated. Usually, the dull-gray base metal was exposed after a few more drops.

##### B. Hot-dipped Zinc Coatings:

The thickness factors for galvanized zinc coatings (Table I) were obtained with samples of galvanized sheet steel from 6 different sources. With both the ammonium nitrate reagent, N<sub>11</sub>, and the chromic acid reagent, the average deviation of the factors from the mean was about ±4 per cent, and the maximum deviation ±10 per cent. This shows that there was no important difference in the rate of solution of hot-dipped zinc coatings from different sources. The ammonium nitrate reagent had a factor close to unity and a small temperature coefficient, as reported by Hull and Strausser.

The results of some measurements on hot-dipped zinc-coated electrical fittings are shown in Table II. No diffi-

**TABLE II.**  
**Thickness Tests on Commercial Coatings.**

Coating		No. of Sources	NH <sub>4</sub> NO <sub>3</sub> Reagent	NH <sub>4</sub> NO <sub>3</sub> * + K <sub>3</sub> Fe(CN) <sub>6</sub>	Average Per cent Error		Magnetic	
Type	Base Metal				CrO <sub>3</sub> Reagent	Jet Method	Not Bur-nished	Bur-nished
Electro zinc	sheet steel and cast iron	5	-12	± 6	-12	± 7	±11	±13
Electro zinc + Hg	sheet steel	3	+26	+45	± 9	(X)	- 5	- 7
Hot-dipped Zn	sheet steel	2	- 6		± 3		± 6	
Hot-dipped Zn	cast iron	3	-19		±13		-10	
Cadmium	sheet steel	2	-12		+ 7		- 2	- 8
Cadmium	cast iron	5	±28 (X)	+80	-12		+ 6	- 9

X—indicates an unsatisfactory end-point.

\* Ammonium nitrate reagent + 3.0 g/l of potassium ferrocyanide.

culty was experienced in testing these coatings on mild steel, but the end-points of coatings on cast iron were not very satisfactory. The ammonium nitrate reagent,  $\text{N}_2$ , gave no visible color change at the end-point, but an effervescence occurred as the steel was exposed. This was taken as the end-point, but it is not accurate. The end-point with the chromic acid reagent was not visible while the reagent was flowing, and it was necessary to stop the test in order to inspect the surface. The end-point consisted of an area of black iron surrounded by gray zinc. The errors of the measurements of coatings on cast iron were larger than those of coatings on mild steel.

#### C. Sherardized Coatings:

The thickness factors (Table I) for sherardized coatings were obtained on samples from three different sources. For each reagent, the average deviation of the factors from the mean was about  $\pm 7$  per cent and the maximum deviation about  $\pm 17$  per cent.

As no samples of sherardized coatings beyond those used in standardizing the reagent were available, the accuracy of the dropping test on this material could not be determined. The results of the standardization show that thickness measurements should generally be correct within  $\pm 15$  per cent. The end-points were not as sharp as with the other coatings. When the test was made with the ammonium nitrate reagent,  $\text{N}_2$ , the color of the coating became alternately silvery and dark, and there was some danger that the appearance of the silvery layer might be taken as the end-point. However, if the flow of reagent was stopped for several seconds, the silvery layer darkened while the exposed steel did not change in color. The end-point with the chromic acid reagent was similar to that on hot-dipped coatings. The zinc turned dark brown in color. Near the end-point, a lighter colored layer sometimes appeared which was soon penetrated, exposing the silvery colored base metal.

#### D. Electroplated Cadmium:

The data for the standardization of the drop tests on cadmium coatings are shown in Table I. The factor of the ammonium nitrate reagent,  $\text{N}_{\text{Cd}}$ , shows a considerable variation with the type of cadmium coating and has a considerable temperature coefficient, which was not previously reported. The variation of the thickness factor makes this reagent unsuitable for general testing purposes, but it might well be used for plant control of only one type of coating. The chromic acid reagent dissolved the different types of coatings at about equal rates. Its thickness factor also varies with the temperature.

The summary of tests on commercial cadmium coatings is given in Table II. The ammonium nitrate reagent,  $\text{N}_{\text{Cd}}$ , gave a rather large error with some coatings, particularly with certain cadmium coatings on cast iron. This reagent did not give a satisfactory end-point with the latter coatings, as the cadmium coatings turned dark in color and were not distinguishable from the exposed base metal. Addition of potassium ferricyanide to the reagent did not improve the accuracy of the measurements, as the blue color of the end-point did not appear until after the end-point was passed.

The chromic acid reagent gave a good end-point with

all the cadmium coatings, including cadmium plated on cast iron. The errors of thickness measurements were larger for these latter coatings, because of the roughness of the cast iron base metal.

### V. Other Methods

#### A. Jet Method:

The jet method was used only on electroplated zinc coatings (Table II). This method of test proved to be less satisfactory than the dropping test, with respect to accuracy and convenience. The flow of liquid must be stopped in order to see whether the coating has been penetrated, and the area of penetration is small and not easily seen. Also, the reagent recommended for the jet test penetrates zinc-mercury at a much slower rate than ordinary zinc coatings.

#### B. Magne-gage:

The measurements made with the Magne-gage<sup>4</sup> (Table II) were usually accurate within  $\pm 15$  per cent for coatings thicker than 0.0002". Since the surfaces of the commercial samples were usually rough, the readings were not as reproducible as on smooth surfaces, and it was necessary to take a number of readings and average them. Cast iron samples were so rough that reliable measurements could not be obtained unless the coatings were at least 0.0008" thick. Some of the coatings were burnished with a half-inch steel ball before testing with the Magne-gage. This increased the reproducibility of measurements of electroplated zinc coatings on mild steel and of sherardized coatings, but gave somewhat low results with cadmium coatings. Burnishing was unnecessary with hot-dipped zinc coatings. Magne-gage measurements of hot-dipped zinc coatings were consistently about 10 per cent low, probably because of alloying between zinc and steel. Therefore, a correction of this amount should be added to the thickness determined with the Magne-gage.

#### C. Microscopic Method:

Microscopic measurements of the thickness of electroplated zinc and cadmium coatings were difficult to make, because these metals are soft, and flow when polished. Various methods of polishing and mounting were tried. Operators who were experienced with polishing these metals obtained results agreeing within  $\pm 5$  per cent, for uniform coatings on smooth base metals, but the measurements on commercial materials, which had rough surfaces, were less satisfactory. Since a special technique is required for the application of the microscopic method to electroplated zinc and cadmium coatings, this method is not suitable for general testing use.

### VI. Recommendations

From the results of this study, it is recommended that the chromic acid reagent be used for the dropping test instead of the ammonium nitrate reagent. In specifications based on any dropping tests, a minus tolerance of 20 per cent should be allowed.

The most suitable method for umpire testing is that involving stripping by the antimony trichloride reagent.

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1. J. Electrodepositors' Tech. Soc. 8, Paper No. 11, 1933.
2. Monthly Rev. Am. Electroplaters' Soc. 22, 9 (1935); J. Research NBS 16, 209 (1936); RP 867.
3. S. G. Clarke, J. Electrodepositors' Tech. Soc. 12, p. 1 and 157 (1936-37).
4. A. Brenner, J. Research NBS 20, 357 (1938) RP 1081.

## Discussion

CHAIRMAN LIGUORI: Gentlemen, are there any questions?

MR. HULL: First, I want to congratulate Dr. Brenner on his improvement in the dropping method for cadmium and zinc. I would like to ask if he is convinced that the antimony trichloride is a satisfactory test for weight loss compared with stripping in hydrochloric acid, or in a solution in which the base metal is not attacked. It seems to me that there is a strong possibility that the antimony may be deposited on the surface of the specimen which is being stripped and thus introduce an appreciable error in the result obtained.

I also question some of the results of Dr. Brenner's tests on cadmium over cast iron, using the ammonium nitrate solution. These are difficult to reconcile with both Mr. Strausser's and my results on cadmium since we tested cast iron as well as other base metals.

DR. BRENNER: The antimony trichloride stripping test mentioned uses a reagent consisting of 20 gms. of antimony trioxide dissolved in 1 liter of concentrated hydrochloric acid. This stripping method is standard for some zinc coatings and is usually accurate within a few per cent.

I stated that the chromic acid reagent contained 200 gms. of chromic acid per liter and 50 gms. of sulphuric acid per liter. The accuracy of the dropping test on coatings plated on rough base metals, especially on cast iron, is not very high. If the coatings on such base metals are thin, of the order of several ten-thousandths of an inch in thickness, the errors involved may be as high as 20%.

MR. GEISSMAN: Dr. Brenner has referred to the jet test originated by Clarke, but he does not refer to testing of nickel coatings by means of this same jet test using a different solution. I certainly wish that the Bureau of Standards would confirm Mr. Clarke's results. I have used this test for two years now, and obtained satisfactory results with it. I know of three other places in Milwaukee that are using this same test, and they are well satisfied. I know of no other concerns in the United States that are using this test, and Mr. Hothersall has confirmed this statement. He said that I was the first one in the United States who mentioned using this test and he stated that they are obtaining very satisfactory results in England with this test.

I think we should investigate it, be-

cause it is both rapid and cheap to use.

DR. BRENNER: Mr. Strausser did some work on nickel coatings with the jet test at the Bureau of Standards several years ago. At that time he found that the end-point of the test was very good but that the accuracy was not as high as stated by Clarke. Clarke claimed the results of the test were correct within  $\pm 15\%$ , but Mr. Strausser found errors as large as 25%.

These results were communicated to Clarke and sometime later he brought out an additional paper on the subject, in which he found that the jet test solution tended to deteriorate and recommended a new solution which was more stable.

In addition, Clarke found that the specifications for the dimensions of the jet must be more stringent than had heretofore been recognized. Perhaps at the present time the jet test as now recommended will give more accurate results.

Since these modifications were made, we have done no work with the jet test at the Bureau.

DR. W. R. MEYER: I do not think you should compare thickness of hot-dip coatings with electroplated coatings. Practically all specifications on hot-dip coatings refer to weight, rather than thickness and considerable error may be due to alloying that occurs in hot-dip coatings.

Secondly, I wonder why you did not finish or complete the addition of ferrocyanide to ammonium nitrate in the testing of coatings, other than the electroplated zinc and cadmium. Your error in the cadmium analysis was surprisingly high, plus 80% on cast iron.

Third, we have noticed in using the drop test that just on approaching the end-point, the surface turns black, or dark. Have you noticed it and do you have any explanation for it?

DR. BRENNER: Regarding the measurements of hot-dip coatings, I realize that weight specifications may be used. Reducing all measurements to thickness was a matter of convenience as we did not wish to have weight per unit area specified for one type of coating and thickness specified for another. The variation in hot-dipped zinc coatings on sheet steel was small. Six different commercial hot-dip coatings were tested by the dropping test, stripping methods and the magnetic method. Of all the commercial coatings tested, I think the hot-dip coatings showed the least variation. These different tests show that the variations due to this alloy layer, at least, in these six commercial coatings, were relatively small. The results of dropping tests were consistent with those of the stripping method usually within 10% and sometimes within 5%.

Some of the errors on cadmium coatings, using the ammonium nitrate reagent, were rather high. The reason for this is probably the difficulty in recognizing the end-point. In some cases, the recognition of the end-point was little better than a guess.

I have noticed the dark color appearing on the coating of the base metal just before the end-point, in a number of cases, but I have no explanation. I suggest that there may be some impurity in the coating, which finally deposits on the base metal when it is exposed.

## Decision of Judge Barnes on Suit of

United Chromium, Inc., Plaintiff

vs.

Great Lakes Plating and Japanning Co., Defendant

on

The Fink Patents for Chromium Plating

### DECISION

THE COURT (Orally): I shall refer to the Fink Patent No. 1,581,188 as the "bath patent." The application for that patent was filed December 19, 1925. The patent issued April 20th, 1926. Claims 4, 6, 10, 13, 16 and 18 are in suit.

The bath patent discloses a process or method of electrodepositing chromium as distinguished from a formula for a plating bath. The patent disclosed that it was the acid radical which acted as the catalyst, whether that radical is found in the chromic sulphate, in sulphuric acid or is not a sulphate radical at all. The patent also discloses that it is the total of catalyst acid radicals present in the bath, whether of one kind or another, that must be taken into account. The patent expressly mentions four catalytic agents, sulphate, fluoride, phosphate and borate radicals. The patent permits chromic acid

concentrations of from about 150 grams per liter to saturation, perhaps 1,000 grams per liter, but teaches that there must be a ratio between the concentrations of the chromic acid and the catalyst, and gives limits for this ratio.

Does the defendant infringe the bath patent? Defendant's baths contain chromic acid, sulphate, and silicofluoride. Silicofluoride is classified as a fluoride in the books. The patent mentions the fluoride radical. Silicofluoride and fluoride behave similarly as catalysts in chromium plating baths. The defendant says that in using silicofluoride, it does not use any proportions disclosed in the Fink bath patent. The Fink bath patent does not give in definite figures the amount of every catalyst to be used. It does give all the data and instructions to guide those skilled in the art.

(Concluded on page 100)



## Technical Advisors For February Issue

G. B. HOGABOOM, JR.

Consultant in Electroplating  
and Metal Finishing,  
Newark, N. J.

W. G. IMHOFF

President,  
Wallace G. Imhoff Co.,  
Vineland, N. J.

DR. K. SCHUMPELT

Baker & Co., Inc.,  
Newark, N. J.

### Exposure of Chromium Plating to Severe Atmosphere

Q. We have entered into discussion with one of our customers regarding the life of nickel and chromium plated steel. The work involved is cold rolled steel rods for street cars, and the customer insists that they should stand up at least three years out-of-doors. The cars are left to stand out by night on a pier in San Francisco Bay, and are exposed to fog and salt water.

We recommended that they wipe the steel rods once a month and finish with a good protective wax. This

they refuse to do saying, "Well, it's chromium plated; it ought to stand up."

Your comments will be helpful in straightening out this controversy.

A. Both nickel and chromium are attacked by chlorides. This can readily be proven by demonstrating the ease with which chromium plate can be removed by hydrochloric acid.

That nickel is attacked by chloride is attested to by the fact that a chloride is an essential ingredient in a plating solution to effect solution of the nickel anodes. Without some chloride present, the anodes would not go into solution.

The usual decorative chromium deposit cannot be counted on to provide protection against corrosion. It will provide tarnish resistance, but due to the thinness of the chromium film, it cannot protect the metal underneath from severe corrosion conditions. A heavy nickel deposit is of more importance where corrosion protection is desired.

For proof on this last point, obtain a copy of Research Paper RP712 "Protective Value of Nickel and Chromium Plating on Steel" by Blum, Strausser and Brenner, National Bureau of Standards, Washington, D. C. Send 10 cents to the Superintendent of Documents, Washington, D. C. Outdoor exposure tests are described.

The recommendation of cleaning and waxing the chromium plated work is a good one, and it is what the automobile manufacturers recommend for preservation of chromium finished parts.—G.B.H., Jr.

### Cleaning the Hot Tinning Bath

Q. We have several hundred pounds of molten tin which is used for hot tinning and which has formed a film of scum upon it,

which is greasy in appearance, and seems impossible to skim off.

Any suggestions which you can give regarding the purification of tin for hot tinning will be appreciated.

A. Constant use of a tin bath causes it to very gradually become unfit for use. The coating becomes dull and unsightly, various defects appear more often, and a point is finally reached where the quality of the tin coating is such that something must be done about it before operations come to a complete standstill.

There are a large number of factors that can render a tin bath unfit for use so that it is well to examine them separately. Perhaps the most common thing about a tin bath which renders it unfit for use is dirt, oxides and inclusions, just from ordinary routine operations. In some plants the bath is cleansed once or twice every period of operation. This has been done by boiling out the bath with various materials. The purpose of the materials put into the tin bath is to cause an evolution of gas in the tin making it boil as the gases escape up through the bath to the surface. This action brings the dirt, oxides, etc., trapped in the metal up to the surface of the tin where they are skimmed off, and removed entirely from the tin bath. Such articles, or materials as a piece of pine 2" x 4" about 6 inches long on a sharp steel rod may be used.

Pine blocks contain rosin and this causes a boiling action in the metal which brings the dirt to the surface. Raw potatoes and beets have been used for the same purpose as they contain water which turns to steam vapor in the tin bath, and this brings about the same action of causing the oxides to come to the surface. The cleansing of the bath by these methods is called poling or boiling out the bath. Generally sal-ammoniac is dusted on the bath when the boiling

action is finished. This is worked around over the bath with a skimmer and finally the residue of ash and dirt is lifted off the bath. The operations are continued over and over until the tin bath is entirely cleansed of dirt and oxides. This action will clear up the molten metal and give it good coating qualities again.

There are other impurities of a chemical nature in molten tin that may cause trouble. Iron contaminates the tin bath forming an iron-tin alloy. In some baths this tin-iron alloy is of such a character that it sinks to the bottom of the bath; in others, it floats on top. It is called tin dross and must be carefully lifted out of the bath with a small perforated scoop. The operation must be done very slowly and carefully to allow the excess tin to drain back into the bath. Some baths are cleansed with a mixture of sulphur and sal-ammoniac. It is stated that the proportion is about half and half of each.

In tin baths where copper is coated, the bath often becomes contaminated with copper. In some plants the usual practice is to allow the bath to settle and then dip out about 20% of it and replace it with good high quality tin. The tin bath is allowed to cool causing the copper-tin alloy to crystallize and in this condition it can be removed. New tin then replaces the amount of metal and alloy removed from the bath.

—W.G.I.

### Palladium Plating

Q. Will you advise us if heavy deposits can be obtained from palladium solutions, and if so, whether it would be a nitric acid solution or some sort of cyanide solution.

A. A palladium plating solution can be made using a palladium amino nitrite known under the trade name "Palladium P-Salt."

In one liter distilled water, dissolve by heating 50 grams disodium phosphate crystals; 10 grams diammonium phosphate; 20 grams potassium or sodium nitrate.

Dissolve in a small quantity of distilled water (about 100 cc.) 9 grams palladium P-salt (4 grams metallic palladium) and 10 grams diammonium phosphate and boil for about 30 minutes keeping the mixture strongly ammoniacal by fre-

quent additions of ammonia. Then add to the above mixture.

This solution is used at 60°-65° C. with thin sheets of palladium as anodes. These anodes lose only very little weight and it is advisable to etch them with dilute aqua regia before using.

All palladium plating must be done at such low current densities that hydrogen evolution on the cathode is avoided. The voltage should be not higher than 1.3 to 1.4 volts, which will result in a current density of approximately 0.4 to 0.5 amperes per square decimeter (3.7-4.6 amps. 1 ft.<sup>2</sup>).

For building up heavier deposits, the bath can be rather ammoniacal (pH about 7.6 to 8.0) and scratch brushing at intervals will result in a denser and smoother deposit. For shorter bright plates, a lower pH of about 6.6 to 6.8 gives better results. However, the lowering of the pH involves the danger of peeling and curling of the deposit.

The deposition from the ammoniacal solution is around 30 milligrams per ampere minute (theoretically 33 milligrams). If base metals are to be palladium plated, it is advisable to give them a gold strike first in order to avoid oxidation of copper and its alloys in the ammoniacal bath.

It is also advisable to increase the current above normal for a few seconds when the articles are placed in the palladium bath in order to cover them quickly.

Palladium deposits, when unpolished are rather susceptible to finger stains. They take, however, a nice polish.

In working with palladium it should be kept in mind that this metal has a great affinity for hydrogen which it can absorb up to 800 times its own volume. For this reason, palladium or palladium plated articles cannot be electrocleaned without destroying their surface finish.—K.S.

### Buffer Curve for Copper Plating Solution

Q. The buffer curve in the "Plating & Finishing Guidebook" is confusing. If the ideal pH is 12.6 what additions of caustic soda should be made if the pH is 11. What additions of sulphuric acid should be

made if the pH is 13.

A. The buffer curve in the Guidebook shows how much caustic soda is necessary to change the pH a given amount.

With regard to the buffer curve: this shows how much caustic soda is necessary to change the pH some amount. Thus on this particular curve, the solution had a pH of about 10.5 before any caustic was added. When 1 oz/gal of caustic was added, the pH rose to about 12.3 in value. To answer your question on going from 11 to 12.6 pH, note that at these pH points, the caustic addition was from about 0.1 oz/gal (at 11 pH) to about 1.6 oz/gal of caustic (at 12.6 pH). The addition of caustic, therefore, to go from 11 to 12.6 was 1.5 oz/gal.

The curve does not go quite as high as pH 13, the top part just about covering 12.9 pH. At this upper portion of the curve, large additions are necessary to cause any change in pH, for example, it can be seen that the pH does not change much from an addition of about 2.5 oz/gal of caustic to 4.0 oz/gal caustic.

Amount of sulfuric acid to add to go from 12.9 pH to 12.6 pH: the curve shows that to go from 12.6 pH to 12.9 pH an addition of caustic of about 2.4 oz/gal was made. In order to go the other way, an addition of acid is necessary. The small table on the curve can be used to estimate the equivalent amount of acid to the above-mentioned 2.4 oz/gal of caustic soda.

The table shows that 0.4 oz/gal of caustic will be neutralized by 8 cc/gal of sulfuric acid. In this case, we have to take care of 2.4 oz/gal of caustic, six times as much, so that the amount of sulfuric necessary will be 6 times 8 or 48 cc/gal. In making such an addition, dilute the acid first and add slowly with much stirring and with good ventilation.

The actual amount of the additions mentioned is not exact for all Rochelle copper solutions. Some are buffered differently than others (due to different carbonate content and any other factors) and this means that the caustic needed to change the pH by say 0.1 pH in one solution, may be quite a different amount from the amount of caustic needed to change the pH the same degree in some other solution.—G.B.H., Jr.



# Post Scripts

Charles H. Proctor has broken into Florida headlines again with a new development, namely, a cleaner for cleaning fruit. The following is an excerpt from a Florida newspaper regarding his developments: "In the story of man's conquest of the universe, which has reached its height in the marvelous American industrial civilization, the modern agents of scientific research, have been of the greatest assistance. Our great country would not be what it is today, were it not for the testing laboratory, of which the Proctor Chemical Company's laboratory is a conspicuous example in this section."

## Bert Sage Strikes Back

January 21, 1940.

Mr. George Simmons  
c/o Dr. Walter Meyer  
Exalted Keeper of  
Post Scripts  
Dear George:

I am in hearty accord with your sentiments regarding Post Scripts. Long may they rave, 'cause we have fun being panned and seeing those we know being panned for their idiosyncrasies. (If I did not get that one right, then I will have to get a new dictionary). *Editor's note*—I guess you will Bert because you left out one "i".

Appropos (quote from yourself) your suggestion to Bob Leather regarding my "here and there" whiskers, I now realize that they are akin to "spotting out" and perhaps that this does account for my dread of that disease and my deep reverence and respect for those who can truthfully state that they have never seen "spotting out" in spite of the fact that they may be handling all the contributing causes.

Before signing off, I would like to state, that you are no Adonis yourself, and should Bob consider your proposition seriously (polishing men's whiskers on a commercial scale) then should he glance at your profile, he would immediately apply for a R. F. C. loan for expansion of his business.

Hirsutely yours,  
Bert Sage

In accepting chairmanship of a special committee at the December meeting of Los Angeles Chapter, A.E.S., D. M. Bedwell, declared warningly:

"All right, I'll take the job. But remember, like last year, I'll accept it only if I'm the boss."

It reminded Bruno H. Schindler of a bit of dialogue that occurred in one of Wallace Beery's recent films. Beery, master of a tugboat, had enlisted in the

Navy during the first World War, only to find a former rival tugboat owner as his superior officer.

"No, sir," growled Beery in disgust. "I'm resignin' from this man's Navy. I don't play on no team unless I'm the captain."

We understand that Prof. Ed. Baker finally won a bet on the Penn State Football team. It has been rumored that Doc Graham paid off his bet to Ed. with 500 pennies. It looks like Prof. Baker is going on the copper standard or else going to use the pennies for copper plating instead of anodes.



Gerald Powers of Detroit Rex appears to have hooked a large channel-bass, or is it an optical illusion?

I. and E. Chemistry printed the following electrochemical problem:

## Another Laboratory Triumph! (Despite Fire and/or High Water)

### Eradication of Barnacles

John E. Hanson, student savant of the University of California at Los Angeles, reported at the March meeting of the Southern California Section his epochal findings in a recent research on eradication of barnacles from ships' bottoms by chemical means. The investigation hinged upon the postulate that barnacles cannot hang on if the pH of the fluid medium be raised to a sufficiently high value.

On account of shortage of research funds Mr. Hanson could not afford to buy the needed pH meter, and so obtained one on lease, choosing the new nickel-in-the-slot model. At first a great economy was expected by the use of dry-ice slugs instead of nickels, but this plan fell through when the resulting carbon dioxide gas lowered the pH to false values.

The scheme first proposed—namely, that of treating the ocean with sodium hydroxide—had to be abandoned after calculation

indicated that 10<sup>13</sup> tons of caustic soda would be needed. The electrolytic method was then tried, with the barnacle-covered ship as cathode, a carbon rod an anode, and the ocean as electrolyte. This plan failed from lack of current density at the cathode. Finally, a small steel schooner was substituted for the carbon rod as anode. The new plan met with great cathodic success. The anodic success was not so great, however, since the electrolytically freed chlorine from the ocean ate holes in the hull and sank the schooner. Final directions for the new technique are being held up pending trials of alternating current, which may either sink both ships, or debarnacle both, or both sink and debarnacle both.

A man who had been called for jury service asked to be excused.

"On what grounds?" asked the judge.

"We're very busy at the office, sir, and I ought to be there."

"So you are one of those men who think they are indispensable; you think that the firm cannot do without you. Is that it?"

"No sir; far from that. I know very well they can, but I don't want them to find out."

"Excused," said the judge.

Maurice Caldwell, when giving the invitation to attend Grand Rapids Branch banquet on Jan. 20th, tried to make the fellows believe that was his sole purpose in attending the Detroit Branch's meeting, but we know he wanted to find out how to clean die castings as well as the rest of us.—H. N. R.

Reports reaching us via the grapevine route have it that Tom Chamberlain coped those bowling honors at the New Haven Branch's Christmas Party by using a unique system—if you lose a string, double the bet and play another string. Bob "Carl Hubbell" Mooney seemed to have been off form being eliminated after tossing three in the gutter.

Congratulations are in order: — to "Liquid Sulfur" McKeon who is managing to take another of those long vacations—this time to Mexico for two months; to the Chicago Branch A.E.S. for the super-colossal annual meeting run efficiently and most enjoyably:—Post Scripts on the Chicago meeting will be in the March issue; to Dr. William Blum for his projected trip to Los Angeles in March; and to Rudy Hazucha who claims to have found secret of having boys (Post—his batting average is only .250).

Walter R. Meyer



# NEW EQUIPMENT AND SUPPLIES

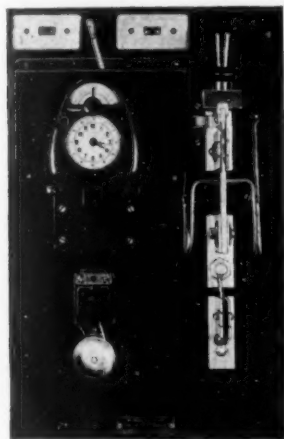
NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

## Automatic Circuit Interrupter

A device for accurately controlling the plating period called, "Automatic Circuit Interrupter", has been developed by Munning & Munning, Inc., 202 Emmet St., Newark, N. J.

The interrupter is a panel board device having a single pole, double throw switch, whose blade is manually locked in position when the work is placed in the tank, and automatically released when a pre-determined time has elapsed. The proper interval is fixed by setting the clock which actuates the trip mechanism governing the circuit breaking blade.

Announcement of breaking is made by a warning bell and pilot light. The ap-



Automatic circuit interrupter.

plications of the interrupter are confined to and recommended for use only in connection with baths which permit arresting of the electrolytic operation, without inducing passivity or chemical attack on the work treated. The use of this instrument is claimed to obviate the human error in plating time, and thus helps to insure strict adherence to specifications.

The interrupter is reported to be simple and rugged in construction, easy to operate and inexpensive. It is available in sizes up to 600 amperes capacity and operative from bus bars of any plating voltage.

## Nickel and Chromium Plated Aluminum Sheet

Two new pre-finished bonded sheet metals, namely, nickel and chromium plated aluminum, have been placed on the market by the American Nickeloid Co., Peru, Ill.

Chromium or nickel is plated electrolytically upon base aluminum sheet by the Krome Alumex process, and exhaustive tests have indicated a high degree of adhesion with a bond that enables the coating to



Some designs of pre-finished metal available.

withstand deformation. These metals permit the obtaining of a surface finish of nickel or chromium with the workability of aluminum.

The pre-finished metals are available in sheet sizes up to 36" x 96", in a full range of tempers and in gauges from 0.010" to 0.064". A choice of bright or satin finish and striped, crimped or corrugated patterns is available.

The company state that they will gladly send test sheets to interested manufacturers or will send a new folder with samples to inquiry upon business letter-head.

## New Small Plating Unit

A new small complete electroplating unit has been announced by the W. Green Electric Co., Inc., 192 Broadway, New York City.

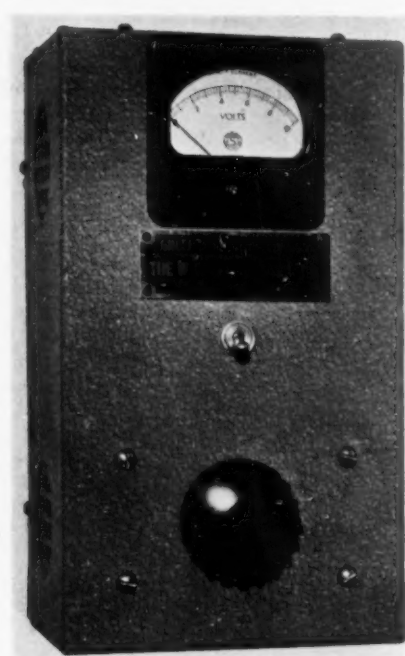
This unit, called "Selectro-Plater" has been designed by Joseph B. Kushner, Ch.E., and the engineers of the International Telephone & Telegraph Company. The unit incorporates a selenium stack rectifier so that AC line voltage from 105 to 125 volts can be used.

The unit delivers 7½ volts and 4 amperes on continuous load and will give 8 amperes on intermittent load or flash plating.

The rectifier unit weighs only 10 pounds, and is 10" x 6" x 5" in dimensions. It can be placed on end, laid down or hung on a wall.

Preparation for plating consists simply of plugging into the AC electric outlet, connecting the cathode and anode leads to the binding posts, and plate. A single knob variable control is available for adjusting the voltage.

The unit contains no moving parts and



Small plating unit with rectifier.

has a special type fuse for protecting the instrument against excessive currents. This unit should be of interest to jewelers, dental laboratories, small plating plants, trade schools, experimental laboratories and large commercial plants for small plating jobs.

## Nickel Dip Wetting Agent

A surface tension depressant known as Nickel Dip Wetting Agent, has been developed by the Trojan Products & Mfg. Co., 3130-36 S. Wabash Ave., Chicago, Ill.

This material has been formulated for special use with standard nickel dips used in many enameling plants. The manufacturer reports that tests have shown the wetting agent to accomplish marked improvement in the adherence and quality of the nickel coating produced, especially the bondage between the coating and the base metal. The lowered surface tension of the dip promotes more uniform deposition in recessed areas and seams, and for batch processing the lining or streaking of the ware is eliminated.

Sludge and scum formation is claimed to be reduced by the use of the wetting agent.

In addition to increased solubility of the nickel solution, better rinsing with lower drag-out losses is claimed for the use of the material.

Technical information regarding its application is available to any branch of the porcelain enameling industry.

## Decision of Judge Barnes on Suit of

United Chromium, Inc., Plaintiff

vs.

Great Lakes Plating and Japanning Co., Defendant

on

The Fink Patents for Chromium Plating

(Concluded from page 95)

The defendant contends that the use of a fluoride radical is anticipated by the Hambuechen patent. It is not so. Hambuechen did not disclose anything about radicals as such or their catalytic effect.

The Court is of the opinion that claims 4, 6, 10, 13 and 18 are infringed.

What was the date of Fink's invention disclosed in the bath patent? There has been a great deal of controversy on this subject. Upon consideration of all the evidence, including Fink's solution cards, Nos. 66, 60 and 68, the Court fixes upon May, 1924 as the date of invention.

### The Udy Defense

The evidence, including the Udy records, does not show that, prior to Fink, Udy ever operated a chromium plating bath by the methods stated in Fink's claims. Udy disregarded catalyst acid radicals in the bath, other than sulphate, and likewise disregarded the ratio of chromic acid to the totality of catalyst. Neither did he regulate the ratio in continuous operation. While Udy did specify limits of chromic acid concentrations and limits of sulphuric acid concentration, he neither specified nor maintained any fixed ratio between these concentrations.

While Udy did have in mind certain inconsequential ratios such as those of trivalent chromium to hexavalent chromium and to sulphate, he did not even consider, let alone specify, the ratio between chromic acid concentration and total acid radical concentration.

The Court holds that Udy's process, if he can be said to have had a definite process, was not that of the Fink Patent.

Having reached the conclusion which has just been stated, it is unnecessary to consider at length the defendant's charge of bad faith on the part of the plaintiff in connection with the Udy matter. It is sufficient to say that the Court's attention has been called to no evidence that is not as consistent with good faith as with bad faith. Furthermore, no sufficient motive has been shown wherefore the plaintiff or its predecessor in interest would cause a determination of priority to be made in favor of Fink and against Udy, contrary to the facts.

### The Manhattan Defense

The plaintiff contends that Manhattan never had the Fink invention, because (1) they were working upon a fallacious trivalent chromium sulphate theory, (2) they permitted the chromium sulphate concentrations to vary haphazardly, thereby show-

ing lack of appreciation of its effect, (3) they put methyl alcohol in their baths throughout their work, to increase the trivalent chromium, in an effort to overcome the many difficulties which they encountered, and (4) they made up baths which failed to work and which they disregarded [discarded] because they did not know to what the difficulties were due. This happened as late as April, 1925, after more than a year's experimenting. The Court is of the opinion that these contentions of the plaintiff are supported by the evidence, and that accordingly, Manhattan did not anticipate.

### The Sargent Article as an Anticipation

Sargent taught that trivalent chromium of chromic sulphate was the essential thing. Sargent did not teach that acid radicals were the important things that needed to be controlled. Accordingly, he did not teach that the radicals function as the catalyst or that their concentration should bear ratio to the chromic acid concentration within defined limits. Sargent's suggestions as to the regulation of the bath for continuous operation were erroneous. He did not know or teach that the catalyst acid radicals and their ratio to the chromic acid concentration were the critical elements.

An important consideration in connection with the Sargent article is that qualified men who followed Sargent's teachings failed.

The Court concludes that the Sargent article did not anticipate the disclosure in the bath patent.

### Grube Patent No. 1,496,845 as an Anticipation

Haring of the Bureau of Standards, the Manhattan experimenters and Grube all apparently shared the idea that since the Sargent formula failed to give consistently good results, the resulting failures might be cured by the addition of some substance which would produce more trivalent chromium in the bath. There is no evidence that anyone ever successfully used the Grube bath. Haring and Schwartz both tried but failed. There is no evidence that anyone is using such a bath today.

The Court concludes that Grube does not anticipate, and finally concludes that the Fink bath patent is valid.

The Fink Patent No. 1,802,463 will be referred to as the bright plating patent. The application for this patent was filed September 19, 1925 and the patent issued April 28, 1931. Claims 1, 2, 3, and 4 are in suit. Under this patent the plating is

done in a bath of proper composition, under controlled conditions determined by a well defined limiting coordination of cathode current density and bath temperature in relation to the concentration of the bath. Defendant denies infringement of this patent because of alleged difference of catalysts. The Court has decided this question adversely to the defendant in connection with the consideration of the so-called bath patent and adheres to that conclusion.

In the Court's opinion, all four claims of the Fink bright plating patent are infringed.

What is Fink's date of invention? The evidence discloses that Fink conceived his invention certainly as early as May, 1924, he proceeded diligently to reduce his invention to practice, and from that time until the filing of his application he was producing bright plating in accordance with the method of his claims and he did reduce the entire claim to practice by the filing of his application. Accordingly, he is entitled to a date of invention, as of the date of his conception, which was certainly as early as May, 1924.

Did Haring anticipate the bright plating patent? Haring did not know anything of the method of the bath patent until December, 1926. Furthermore, he did not begin his work until November, 1924. Before that date, Fink had conceived his invention, was doing bright plating and was getting together the data which was embodied in the bright plating patent. Haring did not anticipate.

Did Udy anticipate the bright plating patent? Udy never used the method of the bath patent. Furthermore, Udy believed that temperature alone was the controlling factor, and Udy had no idea of coordinating temperature and current density. He did not anticipate.

Did the Pfanhauser article of June 18, 1924 anticipate? Pfanhauser, like Haring and Udy, knew nothing of the method of the bath patent and he did not indicate the need for coordinated temperature and current densities. Before June 18, 1924, Fink had conceived his bright plating invention and was using it with his bath invention. Pfanhauser did not anticipate.

The Court concludes that the Fink bright plating patent is valid.

Counsel for the plaintiff may, within 10 days, prepare and, within like time and on notice, present drafts of findings of fact and conclusions of law and a decree not inconsistent with what the Court has stated.

Counsel may take and keep, subject to the order of Court, the exhibits of their respective clients. I will return to you gentlemen some papers which you handed to me. Here are three original exhibits. Here are some papers that are not exhibits.

Let this transcript be filed of record.  
November 29, 1939.

John P. Barnes,  
Judge.

# 1% NICKEL *made 'em...*

## ...100% HAPPIER



**FOUNDRY FOREMAN** quit cussing when 1% Nickel increased fluidity and promoted better casting qualities from heat to heat.



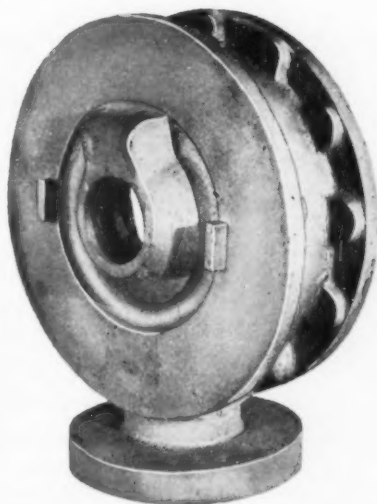
**BOSS** started smiling when rejects stopped eating profits — no foundryman ever gets rich on rejects. Nickel added to bronze assures pressure tightness, increases tensile and compression strength, adds hardness with little or no loss in ductility; simplifies machining.



**CUSTOMER** relaxed when these Nickel bronze castings for locomotive boiler feed pumps withstood required pressure tests—and were sound and dense throughout.



**CONSULTING ENGINEER** beamed when finished Nickel bronze castings held pressures and, despite high temperatures, "proved satisfactory in every way."



### PRESSURE-TIGHT CASTINGS

These locomotive boiler feed pump castings were produced of a Nickel bronze composition:

COPPER .....	85%
ZINC .....	5%
LEAD .....	5%
TIN .....	4%
NICKEL .....	1%

Castings by Textile Machine Co., Reading, Pa., for J. S. Coffin Jr. Co., Englewood, N. J. E. L. Schellans, Consulting Engineer.

## CAST NICKEL BRONZES

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.**



## New Type Buff

A new type buff has been offered to manufacturers by the Bias Buff & Wheel Company, Jersey City, N. J.

This buff, known as Type "K" is specially designed for work that requires a hard face and that can handle large pieces.



*Overlap ply bias buff.*

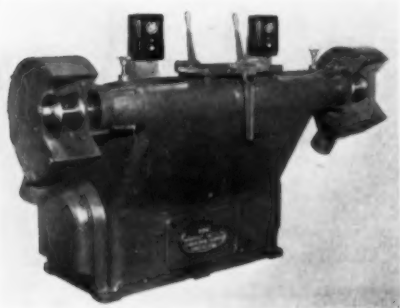
It is reported to be a fast worker and to wear evenly and slowly. An overlap ply feature and the bias formed cloth are said to contribute to its performance qualities.

## Polishing and Buffing Lathe

A new polishing and buffing lathe called Model "2MIS" has been added to the line of the Rome Machinery Sales & Engineering Co., 627 Webster St., Rome, N. Y.

This lathe is arranged for independent wheel operation, having two spindles and two motor lathes available to 10 HP per wheel spindle.

Standard optional equipment, adaptable to this and other lathes manufactured by



*Variable speed polishing and buffing lathe.*

this concern, includes taper screw points, variable speed wheel drives, composition applicators, high speed auxiliary wheel spindles and abrasive belt grinding attachments.

The features stated for this lathe are alloy steel wheel spindles; heavy duty, precision ball bearings; automatic controlled tension bases to provide increased V-belt life and overhanging base for wide foot room.

## Tilting Tumbling Barrels

The Globe Machine & Stamping Co., 1245 W. 76th St., Cleveland, Ohio, has recently announced a new line of tilting tumbling barrels.

Incorporated into the new design are extra heavy castings made from semi-nickel steel and iron for greater durability and economical performance under severe working conditions. All moving parts are lubricated by means of alemite

greater uniformity in the finish of the parts in less time and at less cost than is possible with the ordinary flat bottomed barrel.

The barrels are available equipped with wood shells for cleaning and finishing parts where the volume is not great enough to warrant the purchase of expensive burnishing equipment. The ease of operation for producing a bright finish in a



fittings which feed into extra large pockets around all bearings and shafting insuring smooth operation and minimum power consumption in addition to longer life.

The new style barrels are equipped with patented work-shifting bottoms. The work shifting bottom is securely welded in the inside of the shell forcing the load to shift alternately forward and backward, as well as tumbled around in the revolving barrel, thereby said to impart

short time is reported to be constant in Globe wooden barrels. The parts to be brightened and finished are placed in the wood shell and a sufficient amount of sawdust is added to absorb the moisture. After the barrel has revolved for a short period, it is, while rotating, tilted to a lowered position, thereby permitting the sawdust to drain through a sieve cap, leaving the parts bright and dry in the shell.

## Professional Directory

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All reagent solutions made up for the chemical analysis of any plating solution. Guaranteed pure. Send for price list.

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Roselle, N. J.

#### G. B. HOGABOOM, JR. & CO. Consulting Chemical Engineers

Solution analysis, plant design, process development. Testing of deposits—composition, thickness, porosity, salt spray.

352 Mulberry St. Newark, N. J.

#### J. B. KUSHNER, B.S., Ch. E. "Personalized Plating Service"

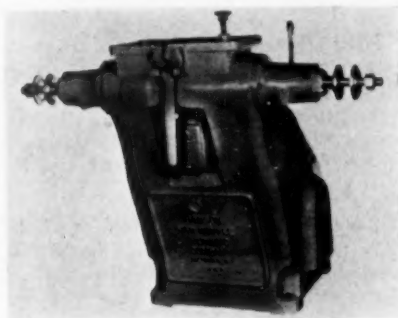
Plating bath analyses made on your premises. Installations. Advisory service.

192 Broadway, N. Y.  
COrtland 7-1158

## New Buffing and Polishing Lathe

A new lathe for buffing and polishing metals has been developed and placed on the market by the Hanson-Van Winkle-Manning Co., Matawan, N. J.

This lathe, named Type MI, is said to be a compactly built unit of rugged construction and designed to eliminate vibration, assure smooth performance and long life. The spindle turns on ball bearings which are of oversize capacity, precision made and precision mounted, lubricated by an oil reservoir; all contributing to long life. The spindle drive is through heavy duty high speed "V" belts and accurately machined sheaves. A sturdy spindle lock is provided. The lathe has a 12" overhang of the spindle to provide work clearance.



New buffing and polishing lathe.

The method of changing "V" belts is new and simple. By loosening a few bolts, the change can be quickly made without disturbing spindle bearings or alignment. Any spindle speed within the range of 1800 to 3600 RPM can be secured. Other speeds may be had by changing the motor sheave pulley. "V" belt tension can be adjusted by a hand wheel at the rear.

The motor is continuous duty N.E.M.A. standard, ball bearing equipped and protected by a magnetic starter. Bronze spindle nuts reduce wear on the flat top spindle threads. Spindle flanges are of heavy cast iron, machined all over. Both ends of the spindle are tapped for taper points.

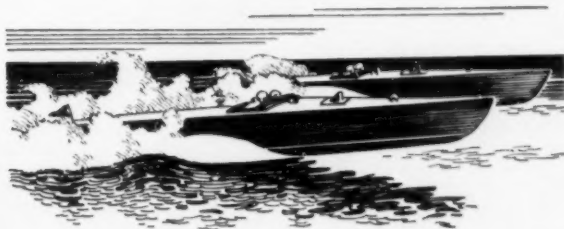
A tray is included for composition and tools. A wrench hook is provided. A start-stop lever is included for starting and stopping of motor by means of a switch operating through the starter. A spindle brake, automotive type, is furnished as part of this equipment to bring the spindle to a quick stop in order to change wheels.

Base dimensions on all sizes are 26" wide x 24" deep. Sizes are 3, 5, 7½ and 10 HP. Weights, from 1265 to 1540 lbs. The lathe is furnished for 220, 440, and 550 volts, 2 or 3 phase, 60 cycle A.C. power circuit; also supplied special for other A.C. or D.C. circuit.

### Photo-Electric Colorimeter

A photo-electric colorimeter, designed for pH-determinations as well as for chemical analysis, is being announced by Dr.

## Out of the Spray—to a Winning Finish

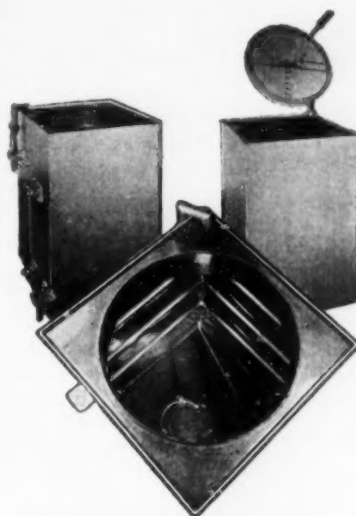


The last and most important thing,—in winning with plating,—as in motor-boat racing,—is the FINISH.

In the race to lower time records and reap the cup of rewards that fine finishing brings, "VORTEXEDDY" spray is designed to help your plating finish,—finish in first place.

"Rinsing With Spray the Storts Way" tells you how to be there at the finish,—with your finishing. Write for your copy of this no obligation booklet,—NOW.

"VORTEXEDDY" Spray Rinse Tanks are distributed by The Udylite Corporation. Their nearest office will gladly and promptly serve you.



The Udylite Corp., Chicago, Ill.  
The Udylite Corp., Detroit, Mich.  
The Udylite Corp., New York, N. Y.  
The Udylite Corp., Cleveland, Ohio  
J. C. Miller Co., Grand Rapids, Mich.  
Donald Sales & Mfg. Co., Milwaukee, Wis.  
L. H. Butcher Co., San Francisco, Cal.  
L. H. Butcher Co., Los Angeles, Cal.  
Electroplating Inc., Atlanta, Ga.  
MacDermid Inc., Waterbury, Conn.  
F. H. Bathke, St. Paul, Minn.

## STORTS WELDING COMPANY

42 STONE STREET

MERIDEN, CONNECTICUT

Manufacturers of Welded Fabrications to Specification

F. Loewenberg, 10 East 40th Street, New York City. The instrument covers the entire pH-range for investigation and control of plating solutions, lacquers and synthetic finishes and can be used in every field in

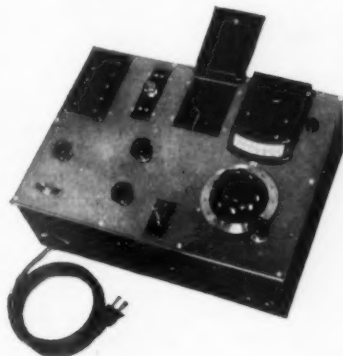


Photo-electric colorimeter.

which the concentration of hydrogen ions is found to be an important factor. The colorimetric pH determination by means of the new colorimeter is accurate, rapid and simple once the instrument has been calibrated by means of a series of solutions which contain all the same amount of indicator solution but are buffered to various pH values. The use of light filters in the determination of the light absorption of the liquids increases the precision of the measurement.

The Lumetron Colorimeter uses two blocking-layer photocells in a balanced circuit. This makes it possible to operate the instrument from the power line without the use of batteries or constant-voltage transformers. Line voltage changes have no effect upon the readings obtained. Light from a concentrated filament bulb is condensed, by an optical system, to form a parallel beam which passes at

## STAINLESS STEEL POLISHING COMPOUNDS

Are Proven Every Day in Every  
Kind of a Metal Working Plant



"4-A" Polishing Compounds Are Faster, More Efficient, More Economical  
for Polishing, Mirror Finishing of All Kinds of Steel, Including Stainless  
Steel and Other Alloys.

## CEMENT AND THINNER

Use it on any kind of a wheel, soft, hard, medium. Results will speak  
more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A"  
product that will solve your problem. No obligation, of course.

*Instead of glue, use "4-A" Cement and Thinner, a uniform substitute  
for polishing Wheels, Belts, Buffs, Rolls, etc. Samples of  
Compound or Cement sent on request.*

**HARRISON & COMPANY**  
HAVERHILL, MASS.

right angles through the plane parallel sample holder so as to avoid errors due to differences in the refraction of the liquids being tested. The filter holder for standard 2" x 2" filters holds the filters firmly at right angles to the light beam and is so arranged that the same filter serves both photocells. The intensity of the lamp can be controlled by means of a rheostat. By operating a key switch, the electrical circuit is changed so that the intensity of light incident upon the cell can be read directly on the galvanometer. In this way, it is possible to allow not only for changes in the light output of the lamp but also for the light absorption of the filter which is used in each case. The light on the photocell can, thereby, always be kept within a narrow range and at low level which is an absolute prerequisite for consistent results in view of the inherent properties of blocking-layer cells. In order to obtain a linear

response of the cells, they are connected in a zero-potential circuit so that they operate virtually under short-circuit conditions when the galvanometer shows balance. Special attention has been paid to reducing the influence of thermal effects upon the photocells, the models having powerful lamps being provided with forced draft ventilation.

Two knobs, one for coarse, the other for fine adjustment, are used to balance the circuit with the standard solution in place. After the sample is inserted, balance is restored by turning a potentiometer which is provided with a calibrated dial and a vernier knob for fine adjustment. For protection against overload, the galvanometer is equipped with a protective resistor. When the instrument is near balance, the resistor is cut out by means of a key switch and the full sensitivity of the galvanometer is used for the final adjustment.

## Manufacturers' Literature

**Bonded Metals.** A 4-page folder describing nickel and chromium plated aluminum sheet, which offers to the industry the tarnish and corrosion resistance of chromium and nickel and the workability of aluminum. American Nickeloid Co., Peru, Ill.

**Corrosion Resistant Tape.** Bulletin WR-101. An improved covering for electroplating racks. A synthetic thermoplastic resin in tape form, resistant to all cleaning, pickling and plating solutions commonly used, including chromium and bright nickel. It is stated to contain nothing to contaminate the solution. Hanson-Van Winkle-Munning Co., Matawan, N. J.

**Filter Press Paper.** Bulletin No. 6 describes a new long fiber, high wet strength filter paper to be used in filter presses. This paper is used on top of the filter canvas to enable rapid and clean removal of the filter cake. The Enthone Co., New Haven, Conn.

**Gang Type Tumbling Machine.** A bulletin recently issued by Munning & Munning, Inc., 202 Emmett St., Newark, N. J., describes a new oblique gang type tumbling machine. The tubs are mounted on thrust bearings, are light and detachable and readily lifted off their spindles for filling or emptying. Direct heating by open gas flame is possible.

**Gold Plating Unit.** A new bulletin from Munning & Munning, Inc., 202 Emmett St., Newark, N. J., describes new gold plating units available. These units consist of double welded sheet steel jacketing tank and triple porcelain lined insert tank, with control attachments and conductor bar system.

**Pickling Addition Agent.** A 4-page folder describing "Pickleen," a liquid wetting and penetrating agent, which is stated to reduce drag-out losses and impart better action to hydrochloric and sulfuric acid pickles. Bulletin No. 5. The Enthone Co., New Haven, Conn.

**Pickling.** International Nickel Co., Inc., 67 Wall St., N. Y., discusses the merits of Monel crates, baskets, tanks, and chains for pickling, in a folder recently published.

**Solder.** An illustrated folder describing "Meltomatic" paste solder of the Wayne Chemical Products Co., 9600 Copeland St., Detroit, Mich. This solder is in paste form with the flux included so that soldering can be effected by applying the paste followed by heating.

**Soldering and Tinning.** "Short Cuts and Better Methods of Soldering and Tinning" is the title of an illustrated booklet containing information on the proper use of various solders supplied by Glaser Lead Co., Inc., 31 Wyckoff Ave., Brooklyn, N. Y. It also contains suggestions for labor and material saving of the solder.



**Hand Handling.** A four page folder describing and illustrating the various products of Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn, N. Y. Among these products are T.P.C. safety siphon, carboy truck, carboy tilter, M-3 dust respirator, GR-250 goggle respirator, G-520 airtight rubber goggles, acid buckets and dippers, etc.

**Belts.** Catalog Section 2180 is a 24-page booklet of the B. F. Goodrich Company, Akron, Ohio, giving data on V-belt practice, pressed steel sheaves, groove angles and belt selection information.

## New Books

**The Machining of Copper and Its Alloys.** Issued by the Copper Development Association, London, S.W. 1, Eng. Publication No. 34. Size 8 $\frac{3}{4}$ " x 6 $\frac{1}{4}$ "; 102 pages. Sent free to those giving evidence of responsible status or genuine interest.

This publication discusses the machining properties of copper alloys and summarizes modern machine practice as applied to these materials. Copper alloys are classified and general machining practice in regard to tool design, rigidity and cutting tool materials, is next considered. Speeds and feeds, cutting lubricants of all types, and tool operations are thoroughly discussed.

The appendix contains specifications and valuable tables.

**Production Management.** By A. M. Simons. Reviewed by H. P. Dutton. Published by American Technical Society, Chicago, Ill. Size 8 $\frac{1}{2}$ " x 6"; 588 pages. Price \$3.50.

This popular book on Production Management is now in its 2nd edition.

The book should be of considerable interest to those engaged in both production and management. The location and planning of industrial plants are considered as well as departmental organization and control in industrial organizations. Labor and service policies are considered at length, as well as industrial training and personnel problems.

**Metallurgical Abstracts (General and Non-Ferrous)** Volume 5, 1938. Edited by S. C. Guillian. Published by the Institute of Metals, London, S.W. 1, England. Size 8 $\frac{1}{2}$ " x 5 $\frac{1}{2}$ "; 864 pages. Subscription price £4, inclusive of two "Proceedings" volumes.

The volume of Metallurgical Abstracts that has just appeared is the largest ever published.

The term "metallurgy" has been very widely interpreted and the subjects of the abstracts range from the electronic structure of matter to workshop hints on soldering and brazing.

In times such as the present, when the efficiency of the non-ferrous metal industries is so vitally important to the nation, "Metallurgical Abstracts" performs an in-

# Silicosis in the Polishing Room

- Tripoli, Coloring Compounds and some other buffing compositions are composed essentially of silica in the particle size which causes silicosis.
- Recent medical investigations have shown that aluminum dust when present with silica dust prevents silicosis.
- It has long been known that the presence of aluminum dust in buffing compounds will aid in cleaning when alkaline cleaners are used. A patent owned by us covers the use of aluminum dust in buffing compounds.
- Superintendents, and foremen in charge of polishing rooms, will be interested in this method of reducing their risk without any sacrifice of their composition efficiency.
- Those interested should write for further information. A very interesting booklet giving full details will be sent.

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estimable service, and it can be said without the slightest hesitation that no one whose work requires that he should keep abreast of the latest developments in metallurgical science and technology can possibly afford to be without this volume.

**Strategic Mineral Supplies.** By G. A. Roush. Published by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, 1939, 485 pages. \$5.00. Reviewed by C. L. Mantell, Ph.D.

This book is the outgrowth of a series of articles which appeared in the *Military Engineer*. Since 1914 the author has been editor of *The Mineral Industry*, which is an annual statistical and technical review of world supplies, production, and con-

sumption of individual minerals and metals.

The volume is particularly timely. After a preliminary chapter on strategic and critical minerals, and another on a general survey, the individual substances are dealt with specifically. These include manganese, nickel, chromium, tungsten, tin, aluminum, antimony, mercury, platinum, mica, iodine, and nitrogen, each dealt with from the viewpoint of industrial and military requirements, of the ordinary essential and expected uses, the possibility of substitutes; the ores, the method of working, and the ore reserves. From the statistical viewpoint, each material is dealt with from the angle of world output and supply, which in turn is compared with the United States output and supply. These lead on to

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## Speedier Action?

You get such unusually fast wetting and penetration with MAGNUS ELECTREX CLEANERS that the entire operation is speeded up. Even before the current gets to work the cleaner is penetrating and dispersing the dirt particles, insuring more effective "plating off" of the more deeply bonded dirt, for which the electrocleaning operation is intended.

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With MAGNUS ELECTREX CLEANERS you get rinsing speed and thoroughness of rinsing that further speed up the cleaning operation and eliminate the troubles caused by contamination of succeeding rinses and dips which hard-to-rinse cleaners inevitably lead to.

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You get really chemically clean metal surfaces with MAGNUS ELECTREX CLEANERS—quality results that set up new standards for electrocleaning. There's a type to meet your definite electrocleaning requirement.

Electrex 21-X for die cast and soft metal.  
22-X for brass.  
23-X for steel-brass combinations.  
24-X for steel.

### GET THE COMPLETE DETAILS

Ask for a copy of the new Magnus Electrex Bulletin.

## MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

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# MAGNUS CLEANERS

the utilization of the ores, their prices, the tariffs and their effects, political and commercial control of the supplies from the national and international viewpoints, summed up with a general review of the domestic situation, the lessons from the last war, and analyses of methods of meeting the problem of adequate supplies. The book concludes with chapters on domestic self-sufficiency and strategic mineral supplies in foreign countries, with a final chapter on commercial versus political interests.

The volume warrants close attention and study by those interested in the international aspects of production and consumption of minerals. Throughout the book

occasional sentences present concise pictures as, for example:

"All told, a surprisingly large percentage of the strategic mineral imports of Germany, Italy, and Japan have been obtained from Great Britain and France or their colonies, with a smaller amount from Russia. The United States has also entered the picture in a large way."

The final paragraph delineates the interrelation of mineral supplies and the maintenance of peace among the nations of the world.—C.L.M.

### TECHNICAL PUBLICATIONS

Progress Reports—Metallurgical Division.  
*Ore-Dressing Studies.* R. I. 3469. Bureau of Mines, Washington, D. C.

## Associations and Societies

### American Electroplaters' Society

#### "Wing Your Way to Dayton"

##### Boston Branch

The annual educational session and banquet of the branch will be held Saturday, April 13, at the Hotel Statler, Boston.

Colgate Gilbert, chairman of the committee, has announced the following members:

C. O. Hardy, H. Lack, E. DeLorme, A. Collins, W. Jones, A. Blake, T. Barron, E. Jeveli, W. Bullard, R. Magnuson and A. Garrett.

##### Los Angeles Branch

General arrangements for the educational and entertainment features of the annual Educational Session of Los Angeles Branch, which is to be held at Hotel Roosevelt in Hollywood March 30, were made at a meeting of the arrangements committee at the home of General Chairman D. M. Bedwell, 159 West 104th St., Los Angeles, on the night of January 15.

Present were Mr. Bedwell; President Ray Bray; Secretary-treasurer Ray Sullivan; E. R. Holman, who as librarian of the branch will serve as chairman of the educational session; M. D. Rynkofs, E. L. Lamoureux, William A. Vensel, Bruno H. Schindler, Herold O. Kroeschke and Earl Coffin.

Chairman Bedwell announced that invitations were to be sent to all west coast electroplaters in addition to general invitations to eastern and middle western branches of the A.E.S.

Two educational sessions were arranged for: One from 9:30 a.m. till 12 noon; the other from 1 p.m. to 4:30 p.m. Although the entire program of the educational sessions was not completed at this meeting, it was announced by Mr. Lamoureux, sub-committee chairman, that definite promises of attendance had been received from Dr. William Blum, of the National Bureau of Standards, Washington, D. C.; and J. C. McCallum, Berkeley, Calif., chairman of the American Society for Metals. Dr. Blum will address the morning session on "A Summary of the Researches on Plating at the National Bureau of Standards," and the afternoon session on "Specifications for Electroplating Coatings." Mr. McCallum will speak at the afternoon session on "Electrodeposition of Alloys."

Provisions for handling an attendance of approximately 125 at the morning and afternoon sessions, and some 200 at the dinner in the evening were discussed at the meeting. The dinner will begin at 7:30 p.m., in the Hawaiian Blossom Room of the Roosevelt Hotel. There will be no scheduled after-dinner speakers—and no

extemporaneous ones, if the plans of the arrangement committee materialize. The evening entertainment features are being designed to harmonize with the Hawaiian atmosphere of the Blossom Room. Incomplete plans call for a Hawaiian string band, singers and other entertainers, including several Hula dance numbers. Hawaiian leis will be distributed among the dinner guests as favors.

#### Milwaukee Branch

Stop—if you haven't heard this one (apologies to Milton Berle).

Stop everything in order to attend the Milwaukee Branch, A.E.S. meeting at the Schroeder Hotel, April 6, 1940.

Complete plans are being made for your entertainment, and rest assured that you will be amply repaid for your attendance again this year.

Milwaukee is a friendly city—remember the date—April 6, 1940—complete program in the next issue.

A. J. Hermansen, publicity chairman.

#### Newark Branch

A. P. Munning of Munning & Munning, Inc., Newark, N. J., will address the branch at their February 16th meeting, the subject of his talk being "The Dynamics of Polishing."

The speaker on March 1st will be W. J. Schneider, DuPont Company, New York, who will talk on "Moly-Black."

#### Providence-Attleboro Branch

A joint meeting of the New England Jewelers and the Providence-Attleboro Branch was held on December 18th at the Rhode Island School of Design in Providence.

The speaker of the evening was Dr. C. B. F. Young, technical advisor to A. Robinson & Son, New York. Approximately 100 people were in attendance to hear the subject "Deposition of Alloys" discussed from both practical and theoretical viewpoints.

The second portion of the lecture concerned research directed by Dr. Young in the field of gold alloy plating. Various factors, such as current density, pH, agitation, etc., were shown graphically.

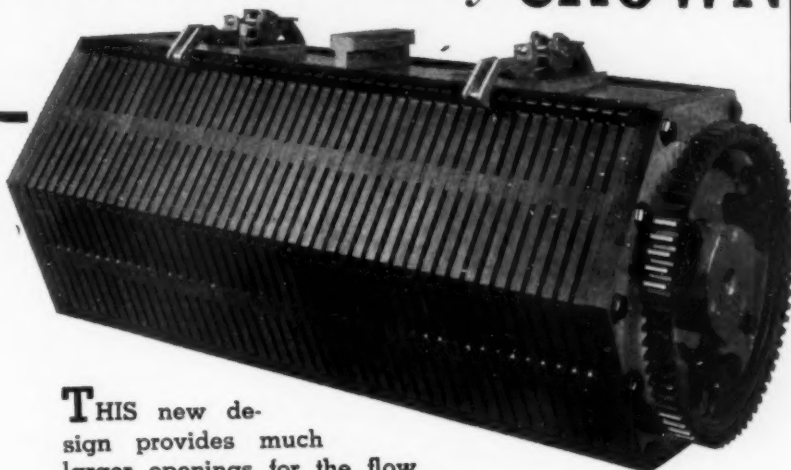
Thanks were extended to B. Robinson of A. Robinson & Son for making the research possible, and recognition was also given for the work done by Messrs. Herschlag, Pflomm and Putnum.

#### Annual Meeting of the New England Branches

Representatives of the Southern New England Branches met in Waterbury at the Hotel Elton on Saturday, January 6th, to formulate plans for a regional spring meeting of these branches. Those attending the meeting were: Wm. Ehrencrona, Eugene Phillips and Dr. Walter Meyer of the Bridgeport Branch; Apley Austin and Joseph St. Pierre of the Hartford Branch; Henry L. Creamer, Joseph Downes, Tom Chamberlain and Robert Gray of the New Haven Branch; Wm. Kennedy and D. S. Hartshorn, Jr. of the Springfield Branch;

## The Newest development IN PLATING BARREL CONSTRUCTION by CROWN

Pat.  
App'd.  
for



**T**HIS new design provides much larger openings for the flow of solution thereby plating a great deal faster . . . The sections are of molded rubber about 3 times the thickness of panel construction which assures longer life and low maintenance cost.

Inside of barrel is well corrugated for the most effective tumbling action.

Write at once for complete details and prices—no obligation, of course.

**Crown**



Complete Plating and  
Polishing Equipment

**Rheostat & Supply Co.**

1910 Maypole Ave.

Chicago, Ill.

Ellsworth Candee, Earle Couch and George Muscio of the Waterbury Branch.

Mr. Kennedy, executive secretary of the Society called the meeting to order. Those present were asked to serve as a permanent committee for the regional meeting. Ellsworth Candee was elected permanent secretary for this committee, and George Muscio, secretary.

It was decided to hold the Regional Educational meeting and Annual Banquet in Waterbury at the Hotel Elton on Saturday, April 27th.

After a brief discussion, Ellsworth Candee appointed the following as chairmen for the various sub-committees: Publicity—J. E. Costigan, Springfield Branch; Hotel, Banquet and Entertainment—Earle Couch, Waterbury Branch; Program—Wm. Ehrencrona, Bridgeport Branch; Educational—Henry J. Creamer, New Haven Branch; Treasurer and Tickets—Apley Austin, Hartford Branch.

## Obituaries

### Matthias E. Cunningham

Matthias E. Cunningham, president of the Waltham Grinding Wheel Co., Waltham, Mass., died suddenly of a heart attack on Nov. 6 at his home in that city.

### Frank Ludlam

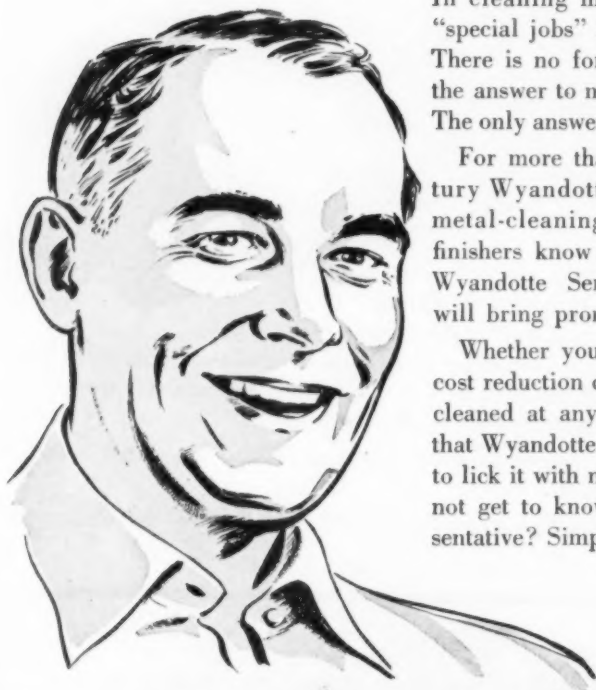
Frank Ludlam, Assistant Secretary and Assistant Treasurer of The International Nickel Co., Inc., died on December 8th at his home at 1130 Park Avenue, New York City, after a long illness.

Mr. Ludlam was born at Bloomfield, N. J., on November 3, 1873. He attended the Lyons School in New York City and the Columbia School of Mines, where he studied architecture. After spending sev-



***I stopped experimenting years ago....  
When I want a special job done, I call***

## **WYANDOTTE!**



In cleaning metal for finishing, "special jobs" are the general rule. There is no formula that will give the answer to most of the problems. The only answer is *experience*.

For more than a third of a century Wyandotte has been solving metal-cleaning problems. Metal finishers know that a call to their Wyandotte Service Representative will bring prompt action.

Whether you have a problem in cost reduction or a job that must be cleaned at any cost, you will find that Wyandotte Service Men are out to lick it with no time wasted. Why not get to know your local Representative? Simply write to—



eral years in architecture and real estate, Mr. Ludlam took a position with The Carnegie Steel Company at Pittsburgh. In March, 1903, he came to The International Nickel Company.

He was a member of the Columbia University Club and the Kane Lodge F. and A. M.

Surviving are two sons, George P. and Kennedy R., of New York City. Mr. Ludlam's wife, the former Amy Roberts, died in 1938.

### **Dr. James Harvey Gravell**

Dr. James Harvey Gravell, president of the American Chemical Paint Co., Ambler, Pa., passed away on December 8 1939.

Dr. Gravell was born in Philadelphia, Pa., in 1880, and was educated in the public schools of Philadelphia, and received a degree of Doctor of Science from the Pennsylvania Military College, Chester, Pa. He was one of the first engineers obtaining many patents on electric welding. In 1914 he became president and director of the American Chemical Paint Co., having been previously connected with the Elwood Ivins Tube Works, the American Tube & Stamping Co., Hale & Kilburne, and the Philadelphia Electric Co.

Dr. Gravell was also president of the Delaware River Ferry Co., Chester, Pa., president of Tide Water Fertilizer Co., New Castle, Del., and chairman of the board of the Grahar Corp., Ambler, Pa.; also a director of the Ambler National Bank. He was a trustee of the Academy of Natural Sciences of Philadelphia and the Pennsylvania Military College; also a member of the Franklin Institute, the American Chemical Society, the American Institute of Electrical Engineers, and the American Society for Metals. He was a Mason, and a member of the Union League of Philadelphia, the Rotary Club, the Engineers Club, Huntington Valley Country Club and the Delaware River Yacht Club.

A brother, Thomas D. Gravell of Philadelphia, survives.



## **HALL-MARK**

*"a mark or proof of quality"*

AND so in buffs as in Gold and Silver—The *Hall-mark* attests the quality.

The Williamsville A1 Stamp is a guarantee of superior materials and workmanship.

**BUY WILLIAMSVILLE BUFFS**

## Personals

### Dr. A. Lloyd Taylor Joins Oakite Technical Staff

Expanding its chemical research facilities and services, Oakite Products, Inc., manufacturers of industrial cleaning materials since 1909, announces the appointment of Dr. A. Lloyd Taylor to its Technical Staff.

Because of his extensive activities in the field of industrial chemistry where he has directed numerous projects covering a wide range of industries, Dr. Taylor brings to his new post a wealth of experience.



Dr. A. Lloyd Taylor

Having resigned his previous position as Director of the Department of Chemistry of Pease Laboratories, New York City, with whom he has been associated for the past six years, he will concentrate his attention primarily on chemical research and development of cleaning materials for production and related cleaning operations of major industries. Dr. Taylor will also devote part of his time to technical field service.

Dr. Taylor will be located at the Company's General Offices, 22 Thames Street, New York, where the research and service laboratories of the chemical and mechanical divisions are maintained.

F. D. Pace is now a manufacturer's agent for electroplating equipment and supplies. His address is 1047 Iroquois Drive, S.E., Grand Rapids, Mich. Mr. Pace was formerly with J. C. Miller Company of Grand Rapids.

F. M. Ruggles of the Mullite Refractories Co., Shelton, Conn., has assumed his new duties as the company's midwest sales representative with headquarters in Chicago, Ill. Mr. Ruggles is a graduate ceramic engineer and enters the sales field with a technical background in refractories. His territory will include Illinois, Wisconsin and Missouri.

At a recent meeting of the Nominating Committee selected by the Board of Directors of the National Association of Waste Material Dealers, Inc., at its Dec. meeting, Harry S. Goldstein of L. Goldstein's Sons, Philadelphia, was unanimously re-nominated for the presidency of the above Association.

—these are meeting every requirement in all polishing and buffing departments

#### Spiral Sewed Type Buff

For hard rough operations. "Cutting down" work. Wears long, lasts. Bias formed cloth never ravel.



#### Overlap Ply Buff

Five sections do as much work as ten sections of an ordinary buff. Less polishing compound used, but more work done — wider face — lower cost.



#### Regular

#### Type Buff

For general work. Cloth in all Bias Buffs from our own mills. Bias cut and formed. Never ravel, nor wastes compound.



#### Gem

#### Loose Leaf Buff

Preferred by some manufacturers for certain types of work. Durable lasting, when made from our superior cloth. All shipments prompt.



**BIAS BUFF & WHEEL Co., Inc.**  
428 Communipaw Ave. Jersey City, N. J.

## WE CONCEIVED THE IDEA YOU BUY GOLD BY WEIGHT IN ROBINSON'S ORIGINAL ASSAYED GOLD PLATING SOLUTION



No Fumes—No Waste—No Continual  
Scrapping of Run-Down Baths  
Healthier Condition in Your Plating  
Room

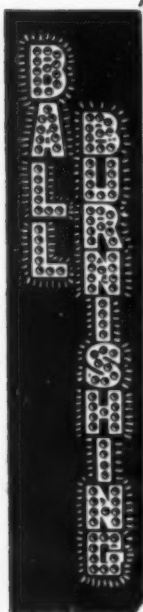
Fast—Clean—Modern—  
Economical

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"Sixty years at Precious Metals"

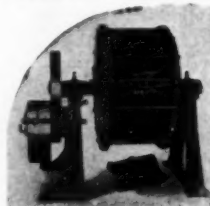
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Prepare for a fine plate first by burnishing small, metal parts. After plating, burnish again. That rolls down the surface, closes pores, increases resistance to corrosion. Pressure does the job. Therein lies the advantage of Abbott high, narrow barrels which take a charge of several hundred pounds of steel burnishing materials. This mobile weight, confined within an upright area, develops maximum pressure on the work. Questions gladly answered. Orders promptly filled.



## The Abbott Ball Company

1046 New Britain Ave.

Hartford, Conn.

### BEFORE Cleaning

Aluminum Cap, smeared with spinning compound and dirt from handling.



### AFTER Cleaning

with PERMAG. No injury to metal. Cleaned 100 per cent. Safe, quick, efficient, low in cost.



### PERMAG Cleaning Compounds

Cleans Aluminum and other soft metals 100%.

Cleans quickly, effectively, economically and positively does not injure the metal. PERMAG Cleaning Compounds handle any cleaning problem of the metal fabricator. Write us about your metal cleaning difficulties.

### MAGNUSON PRODUCTS CORPORATION

Main Office and Factory, Third & Hoyt Sts., Brooklyn, N. Y.

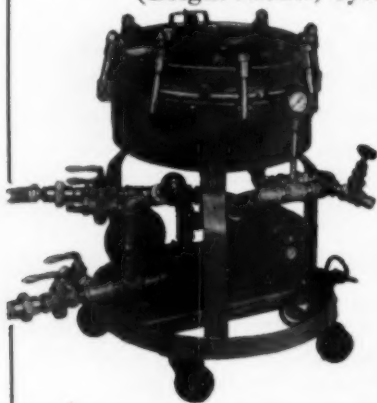
23 years' experience manufacturing, selling and servicing Specialized Industrial Cleaning Compounds for every purpose.

Representatives, also Warehouses in Principal Cities of United States  
In Canada: Canadian Permag Products, Ltd., Montreal and Toronto

## NEW SPARKLER

### HORIZONTAL PLATE ACTIVATED CARBON AND FILTER AID FILTER

ENGINEERED FOR THE MODERN PLATING SOLUTIONS  
(Bright Nickel, Cyanide Copper, Chromium, etc.)



Horizontal plates permit building up more uniform and thicker cake of carbon and filter aid assuring a sharper and more uniform result under all conditions. Horizontal cake is not disturbed by intermittent operation. Very economical to operate and simple to clean. No cloths or screens to wash. No waste of liquid being filtered.

Available in stainless steel, iron or rubber.

Write for free literature.

### SPARKLER MFG. CO.

1214 Webster Ave.

Chicago, Ill.

The Lea Mfg. Co. of Waterbury, Conn. announces the appointment of Edwin C. Jarm of Springfield, Mass. who has served the cutlery industry for the past ten years as development specialist for The Carborundum Co. Mr. Jarm will represent The Lea Mfg. Co. in sales and technical development, giving attention particularly to the cutlery trade.

Problems in surface chemistry will be investigated by Charles M. Schwartz, physical chemist, who has recently become a member of the staff of Battelle Memorial Institute, Columbus, Ohio. His work will entail the use of the Institute's electron diffraction camera, one of the first of its kind, which has been found to be a valuable tool for industrial research.

Dr. Schwartz was formerly on the technical staff of King Laboratories, Inc., Syracuse, and was previously an assistant in chemistry at Syracuse University, from which he received his doctor's degree. He is a graduate of the University of Buffalo, and studied for a year also at the University of Manchester, England, under W. L. Bragg.

Fred K. McCarthy, assistant manager, has been named manager of the Cincinnati branch of the National Lead Company, succeeding the late William A. Dail. The new branch manager has been with the company since 1935.

W. W. Davidson, Vice President in Charge of Sales of Detroit Rex Products Company, Detroit, Michigan, has announced the following promotions effective immediately:

H. R. Norgren has been made Assistant General Sales Manager in Charge of Special Accounts; D. E. Williard, Assistant General Sales Manager in Charge of Regions and Branch Offices; and R. A. O'Reilly, Manager of the Dry Cleaning Division.

A. J. Wadhams, Vice President and Manager of the Development and Research Division of The International Nickel Co. Inc., has announced the addition of Dr. William A. Mudge to the Technical Service Division of the New York Office.

For the past 17 years Dr. Mudge has been Superintendent of Research, Superintendent of the Refinery and Works Metallurgist at the company's Huntington, W. Va. Rolling Mill. Before being transferred to the Huntington Plant, Dr. Mudge spent two years at the company's Bayonne, N. J. Refinery, where he joined International Nickel in 1920.

P. J. Potter, vice-president in charge of engineering, production and sales of the Pangborn Corp., Hagerstown, Md., has been elected president of the Foundry Equipment Manufacturers' Association. He received his early business training with the Michigan Steel Castings Co., which he left in 1915 to represent the Pangborn Corp. in Detroit territory. In 1921, Mr. Potter was appointed works manager at the home plant in Hagerstown and sales director in 1932. He was made vice-president in charge of engineering, production and sales in 1935.



## Verified Business Items

*Hanson-Van Winkle-Munning Co.*, Matawan, N. J., has announced the following appointments and changes: *Ellsworth F. Wilson*, has been appointed to the Engineering Department; *Harvey K. Hunt*, formerly of the Crucible Steel Company, has joined the laboratory staff; *H. E. Moyer* has been appointed sales representative, located at 4324 S. Normandie Ave., Los Angeles, Calif.; *W. W. Wieland* has been appointed sales engineer; *Jack D. Clayton*, as sales representative, located in the Detroit office, at 2842 W. Grand Blvd., and *Harold R. Smallman*, who has been for a number of years in charge of the Chicago office, has been appointed Western manager.

*A. J. Lynch & Company*, color, pigment and chemical manufacturers, and Southern California representatives for the Harshaw Chemical Company, have completed installation of an analytical laboratory for testing plating solutions in their Los Angeles plant, 2424 Enterprise St. According to *Harold J. Kroesche*, head of Lynch & Company's sales and service engineering department, the new laboratory is compactly contained in a floor area 19 x 30 ft., but is completely equipped for testing standard solutions.

*Detroit Rex Products Company*, Detroit, Michigan, manufacturers of solvent degreasers, alkali washers and cleaners, and dry cleaning equipment, announce the appointment of *E. L. McIlhenny* as manager of the Alkali Division. Mr. McIlhenny, who formerly worked out of the Cleveland Office, will have charge of all sales and service of the company's complete line of alkali cleaners.

Mr. McIlhenny is a graduate in chemical engineering from Washburn College and took post graduate work at the University of Minnesota. He has spent the past thirteen years in the metal cleaning industry.

*W. Green Electric Co., Inc.*, 192 Broadway, New York, in the electroplating solution and supply business for over fifty years, has been reorganized and is now under the leadership of *Harry A. Einstein*. The firm intends to expand into the field of moderate size electroplating installations and will shortly announce several interesting new developments in plating and finishing solutions and equipment. They have engaged *Joseph B. Kushner*, Ch.E., consultant on electroplating and metal finishing, to handle all their technical developments and to direct electroplating research in their plating and finishing laboratories.

*American Nickeloid Co.*, Peru, Ill., manufacturer of pre-finished metals, announces the appointment of *Gustavo Sommer*, S. A., Mexico City, D. F., to represent their concern in the sale of American Bonded pre-finished metals in the Republic of Mexico.

# CHROMIC ACID

Recognized as the world's largest manufacturer of chromium chemicals, Mutual brings to the plating industry a basic source of chromic acid.

Our facilities cover every step in its production, from the mining of the chrome ore on a remote island in the Pacific to the wide distribution of the finished product through warehouse stocks in the principal consuming centers.



CHROMIC ACID  
OXALIC ACID  
BICHROMATE OF SODA  
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Mines in New Caledonia  
Plants at Baltimore and Jersey City  
Warehouse stocks carried in all principal cities.

## MUTUAL CHEMICAL CO. OF AMERICA

270 Madison Avenue, New York City

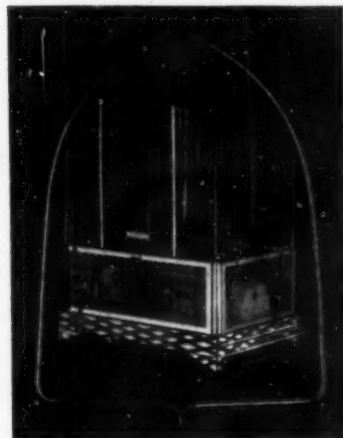
## CASTLES FOR CANARIES

The Taj Mahal for a bird cage, table lamps of silver satin, pens of shimmering gold. American Bonded Metals lend a touch of beauty and vivid imagination to the dull . . . the commonplace . . . to your own product be it an automobile or a cocktail shaker. And do it at a savings to you. Coming to you completely pre-finished, they can be drawn, stamped, formed or assembled into your completed product. Elimination of plating—either before or after fabrication—polishing or buffing provide production savings that mean added profits. Write on your company letterhead for a new brochure covering the latest in pre-finished metals, designs, patterns and ideas.

Sales Offices in All Principal Cities

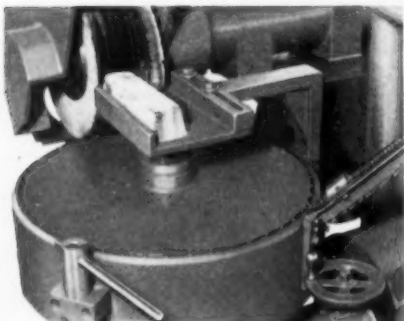
AMERICAN NICKELOID COMPANY

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### It's Quicker With an "Acme"!



Acme Type "SM"

For polishing or buffing flat or oval-head screws—also hinge pins, rivets, lock barrel facings and other cylindrical parts—an Acme "SM" Automatic is three to six times as efficient as the old method. Besides, it produces a better finish, with a minimum of rejects.

This is, of course, but one of the many types of Acme polishing and buffing machines in widespread use for speeding up production and reducing operating costs. If you have a buffing or polishing problem, the chances are there is an Acme machine that will solve it.

Send Sample for  
FREE Production Estimate

**ACME Manufacturing Co.**  
1642 HOWARD ST. • DETROIT, MICH.  
*Builders of AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS*

Easy to Use — EFFICIENT — Economical

**NATROLIN**  
TRADE MARK

**"B-4 CHROME" CLEANER**

Eliminates Rejects from Imperfect,  
dull Chrome Finishes

**SULPHUR PRODUCTS CO.**

Greensburg, Pa.

The Lea Mfg. Co. of Waterbury, Conn., announces the establishment of a research and technical development department for the cutlery industry. The work will be under the direction of specialists in finishing in this branch of the metal-working, namely, Edwin C. Jarm, formerly with The Carborundum Co. and William D. Starr, technical director of The Lea Mfg. Co.

The Great Lakes Carbon Corporation, who at present have under construction at Niagara Falls, N. Y., a plant for the manufacture of graphite electrodes, amorphous carbon electrodes and graphite anodes, announce the appointment of George O. O'Hara as sales manager of their Electrode Division.

Oilgear Co., Milwaukee, Wis., is building a \$40,000 addition to its plant, to house its welding, painting and shipping departments to provide more assembly space. The following departments are operated: brazing, welding, grinding, polishing and lacquering. Principal base metals used are: steel and bronze.

Pacific Radiator Co., Los Angeles, Calif., makers of oven controls, thermostats and safety pilots for heating equipment, are making arrangements to move several departments into a newly completed plant addition, 92 x 157 ft. in area, built at a cost of \$16,000.

Line Material Co., manufacturers of street lighting fixtures, switches and electrical equipment, have announced the removal of their executive and sales offices to 740 N. Second Street, Milwaukee, Wis. Their address for correspondence is P. O. Box 2077, Milwaukee.

Scintilla Magneto Division, Bendix Aviation Corp., Sidney, N. Y., magnetos and parts, etc., has let contract for a one-story and basement addition, 50 x 200 ft. Cost over \$85,000 with equipment. The following departments are operated: stamping, soldering, brazing, grinding, polishing, degreasing, cleaning, plating and buffing.

W. A. Barr has been made executive vice-president and general manager of Foote Bros. Gear & Machine Corp., Chicago, Ill. He will succeed W. H. Fowler who has resigned to become assistant to the president and chief executive officer of the American Machine & Metals, Inc., Moline, Ill., but will remain as director and chairman of the executive committee of Foote Bros.

Charles E. Thornton, for 10 years a member of C. F. L'Hommedieu and Sons Co. sales staff, has been named manager of the Los Angeles branch of that firm, succeeding Mr. Sundmark. He was formerly foreman of the plating department at Douglas Aircraft Co., Santa Monica, and prior to that served in the plating department of the International Sign Co., Los Angeles. Mr. Thornton was a charter member of Los Angeles Branch, A.E.S., and in 1930 succeeded Robert Grip as president. He was secretary of Chicago Branch from 1918 to 1921, and president for the 1921-22 term.



# Supply Prices, February 1, 1940

## Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER: Cast	22½c. per lb.	NICKEL: 90-92%, 16" and over	.45 per lb.
Electrolytic, full size, 17½c.; cut to size	17½c. per lb.	95-97%, 16" "	.46 per lb.
Rolled oval, straight, 17½c.; curved	18½c. per lb.	99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48c.	
BRASS: Cast	19¼c. per lb.	SILVER: Rolled silver anodes .999 fine were quoted from 38c. per Troy ounce upward, depending on quantity.	
ZINC: Cast	11 c. per lb.		

## Chemicals

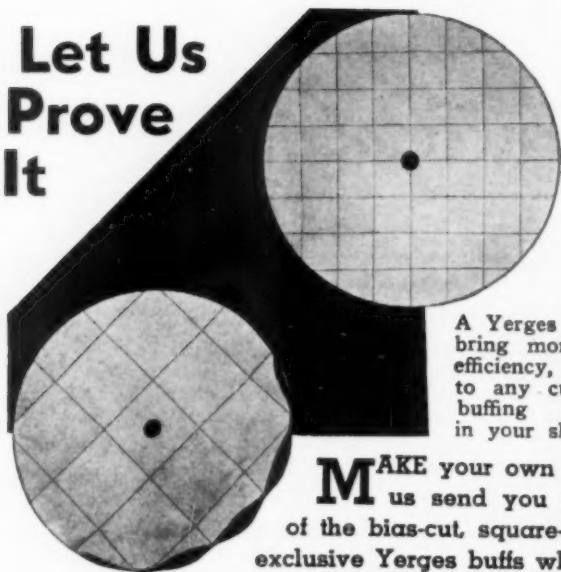
These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, C.P. l.c.l., drums	lb.	.06¾-.07¾	Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059	Sandarac, prime, bags	lb.	.50
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16¾-.17¾	Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027	Iron Sulphate (Copperas), bbls.	lb.	.017
Hydrochloric, C.P., 20°, carboys	lb.	.08	Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Hydrofluoric, 30%, bbls.	lb.	.07-.08	Oxide (Litharge), bbls.	lb.	.125
Nitric, 36°, carboys	lb.	.06	Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Nitric, 42°, carboys	lb.	.075	Mercury Bichloride (Corrosive Sublimate)	lb.	\$1.58
Oleic (Red Oil), distilled, drums	lb.	.09-.10	Mercuric Oxide, red, powder, drums	lb.	\$2.66
Oxalic, bbls. l.c.l.	lb.	.12-.14	Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Stearic, double pressed, distilled, bags	lb.	.12-.13	Chloride, bbls.	lb.	.18-.22
single pressed, distilled, bags	lb.	.11½-.12½	Salts, single, 425 lb. bbls.	lb.	.135-.145
triple pressed, distilled, bags	lb.	.14¾-.16	Salts, double, 425 lb. bbls.	lb.	.135-.145
Sulphuric, 66°, carboys	lb.	.025	Paraffin	lb.	.05-.06
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175	Perchloroethylene, drums	lb.	.08¾
Butyl-normal, l.c.l., drums	lb.	.095-.105	Phosphorus, red	lb.	.42
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.335	yellow	lb.	.55
Diacetone, pure, drums, l.c.l.	lb.	.10-.115	Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¾-.075
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.385-.405	Potassium, Bichromate, crystals, casks	lb.	.09¾
Propyl-Iso, 99%, l.c.l., drums	gal.	.41	Carbonate (potash) 98-100%, drums	lb.	.06¾
Propyl-Normal, drums	gal.	.70	Cyanide, 94-96%, cases	lb.	scarce
Alum, ammonia, granular, bbls., works	lb.	.035	Pumice, ground, bbls.	lb.	.03
Potash, granular, bbls., works	lb.	.0375	Quartz, powdered	ton	\$30.00
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05¾	Quicksilver (Mercury) 76 lb. flasks	flask	\$90.00
Ammonium, chloride (sal-ammoniac), white, granular, bbls.	lb.	.0521-.075	Rochelle Salts, crystals, bbls.	lb.	.21¾
Sulphate, tech., bbls.	lb.	.035-.05	Rosin, gum, bbls.	lb.	5.25-7.75
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	scarce	*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Sulphocyanide (thiocyanate), com'l, drums	lb.	"	Cyanide, 100 oz. lots	oz.	.33½
Antimony Chloride (butter of antimony), sol., carboys	lb.	.19¾	Nitrate, 100 oz. lots	oz.	.27
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03	Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Benzene (Benzol), pure, drums, works	gal.	.21	Cyanide 96%, 100 lb. drums	lb.	.15
Butyl Lactate, drums	lb.	.235	Hydroxide (caustic soda) 76%, flake	lb.	.0355
Cadmium Oxide, l.c.l., bbls	lb.	.85	Hyposulphite, crystals, bbls.	lb.	.035-.065
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05¾-.075	Metasilicate, granular, bbls.	lb.	.0335
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾-.06	Nitrate, tech., bbls.	lb.	.029
Carbon Tetrachloride, l.c.l., drums	gal.	.73	Phosphate, tribasic, tech., bbls.	lb.	.0295
Chrome, green, commercial, bbls.	lb.	.22	Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Chromic Sulphate, drums	lb.	.26¾	Sesquisilicate, drums	lb.	.0425
Cobalt Sulphate, drums	lb.	.65	*Stannate, drums	lb.	.31-.33
*Copper, Acetate (verdigris), bbls.	lb.	.25	Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Carbonate, 53/55%, bbls.	lb.	.17	Sulphocyanide, drums	lb.	.30-.35
Cyanide, Tech., 100 lb. bbls.	lb.	.34	Sulphur, Flowers, bbls., works	lb.	.037-.0410
Sulphate, Tech., crystals, bbls.	lb.	.051	*Tin Chloride, 100 lb. kegs	lb.	.36½
Cream of Tartar (potassium bitartrate), gran., kegs	lb.	.27¾	Toluene (Toluol), pure, drums, works	gal.	.30
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07	Trichlorethylene, drums	lb.	.08½
Diethyl Phthalate, l.c.l., drums	lb.	.195	Tripoli, powdered	lb.	.03
Diethylene Glycol, l.c.l., drums, works	lb.	.155	Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.38-.40
Dextrine, yellow, kegs	lb.	.05-.08	Bees, yellow, crude	lb.	.28-.29
Emery Flour (Turkish)	lb.	.07	Carnauba, refined, bags	lb.	.52-.53
Ethyl Acetate, 85%, l.c.l., drums	lb.	.07-.08	Montan, bags	lb.	.26-.30
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20	Spermaceti, blocks	lb.	.26-.27
Flint, powdered	ton	30.00	Whiting, Bolted	lb.	.025-.06
Fluorspar No. 1 ground, 97-98%	ton	\$60.00	Xylene (Xylol), drums, works	gal.	.32
Fusel Oil, refined, drums	lb.	.125-.14	Zinc, carbonate, bbls.	lb.	.14
*Gold, Chloride	oz.	\$18¾-.23	Cyanide, 100 lb. kegs	lb.	.33
Cyanide, potassium 41%	oz.	\$15.45	Chloride, granular, drums	lb.	.06
Cyanide, sodium 46%	oz.	\$17.10	Sulphate, crystals, bbls.	lb.	.04

\*Subject to fluctuations in metal prices.



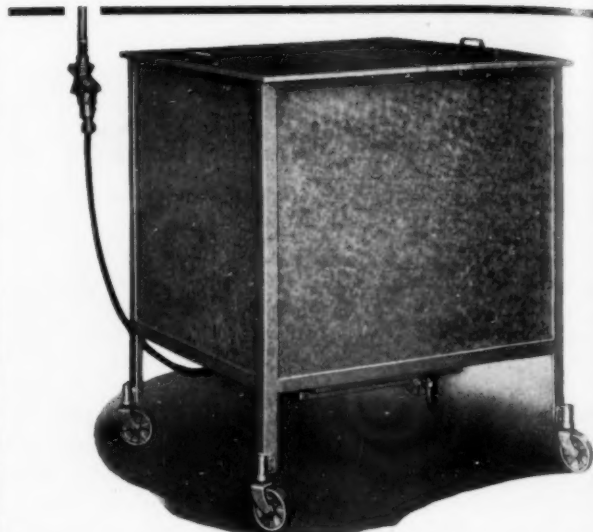
**Let Us  
Prove  
It**



A Yerges buff will bring more speed, efficiency, economy to any cutting or buffing operation in your shop.

**MAKE** your own test. Let us send you samples of the bias-cut, square-stitched, exclusive Yerges buffs which will make possible a new low cost figure on all your cutting, buffing and polishing work. Made for every requirement. Let us send you samples and complete data. The Yerges Mfg. Company, Fremont, Ohio.

**YERGES**



## Reduce Metal Cleaning Time with Phill-Co Portable Degreasers

Phill-Co portable degreasers, the latest innovation in the metal industry, removes Oil & Grease from all types of metal, simply, economically without labor. Handles small jobs, otherwise held up. Here you have Portability, adaptability and LOW OPERATING COST! Ruggedly constructed to withstand abuse.

### NO INSTALLATION REQUIRED!

Take the degreaser to the work instead of the work to degreasers. Simply plug into any electrical outlet and you are ready to start. Above model 220-9 has ten gallon solvent capacity, cleans from three to six tons of work. Solvent is distilled and reclaimed within each machine, and used over again.

Write for new literature and particulars.

Phillips Mfg. Co., 350 West Huron Street, Chicago  
A few localities available for Distributors.

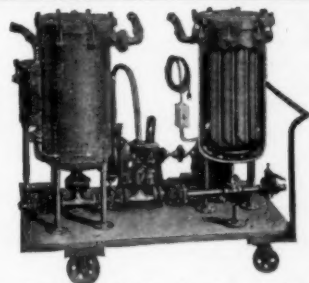
## FILTERS

**Capacity—200 to 2400 Gallons Per Hour  
FOR:—**

- BRITE NICKEL PLATING SOLUTIONS
- ACID & CYANIDE PLATING SOLUTIONS
- HOT SOLVENTS IN DEGREASING MACHINES
- OLEUM SPIRITS, NAPHTHA, GASOLINE & OILS
- LACQUERS, LACQUER THINNERS & ALCOHOL
- ALKALINE CLEANING SOLUTIONS & NEUTRALIZERS

Many important benefits are derived, and big savings effected in metal cleaning and finishing operations, as a result of filtration.

**Industrial Filter & Pump Mfg. Co.**  
3017 West Carroll Avenue Chicago, Ill.



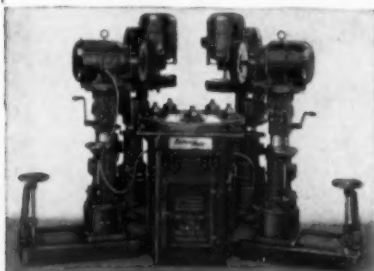
Cut illustrates both closed and internal view of typical filter.

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FEBRUARY, 1940

# ORGANIC FINISHING

SECTION OF METAL INDUSTRY



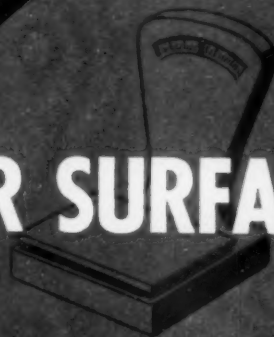
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### INDUSTRIAL FINISHES



# ORGANIC FINISHING

SECTION OF METAL INDUSTRY

FEBRUARY, 1940

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## Uniformity of Finishing Materials

With respect to the uniformity of organic finishing materials which are produced today, the consumer is in a particularly fortunate position. Not so many years ago, it was somewhat a matter of conjecture to both the manufacturer and the user as to whether or not two batches of a finishing material could be depended upon to have the same characteristics and properties. Today, however, the uniformity of most lacquers, enamels and other finishing materials is assured. As a matter of fact, many manufacturers are in a position to guarantee their products within very close limits.

The reason for this general increase in uniformity is twofold. In the first place, equipment and control have been vastly improved. There is no longer any guesswork about manufacturing procedure since each step can be carefully checked and easily duplicated. Secondly, whereas pigments, resins, solvents and other constituents of finishing materials were once likely to be of questionable quality, they are now obtainable in unvarying grades, especially those of synthetic origin. Even raw materials of natural origin are so collected and inspected as to insure consistency and dependability.

It can be safely said that advances in the manufacture of uniform finishing materials will continue. The next few years should see the completion of the work which has already been accomplished and which has given so much satisfaction.

# Organic Finishing of Home Laundry Equipment

By Willoughby G. Sheane

The finishing of home laundry appliances at the Bridgeport Works of the General Electric Co. is an interesting study of the efficiency possible in volume production through the use of carefully planned modern equipment operating under rigid technical control. Despite such complicating factors as the wide range of sizes and shapes and the many different metals which must be processed on the same equipment, thousands of General Electric washing machines and ironers are finished each year in an attractive and durable white enamel on a system comprising four operations which occupy less than fifteen hundred square feet of actual floor space. The whole procedure for any individual part, from uncleaned metal to the final baked finish, requires a maximum of one and one quarter hours and involves the services of only five men, including finishers, handlers and inspectors.

The four operations which constitute the finishing procedure are as follows in order: cleaning, phosphate coating, spraying and baking. Each part of the procedure is described in detail below.

## Cleaning

The first finishing operation is that of removing all oil, dirt, drawing compound, etc. accumulated during fabrication of the various parts. This is accomplished in the alkaline spray washer illustrated in the floor diagram of the finishing department (Figure I) and in Figures II and III. Parts are loaded on the link belt conveyor at Station 1 and proceed through a forceful spray of hot cleaning solution for ninety seconds, a hot water spray rinse of sixty seconds duration, and finally through a steam heated drying compartment in which hot, dry

The equipment and the procedure followed in the finishing of home laundry equipment at the Bridgeport Works of the General Electric Co. is described by the author. Many interesting details on metal cleaning and preparation, finish application and baking are given, along with a process flow sheet and pictures of this highly efficient spray finishing line.



Willoughby G. Sheane  
Chemical Engineer  
General Electric Co.  
Bridgeport, Conn.

air is constantly swept across the work. The cleaning solution is a low concentration combination of buffered alkali and emulsifying agent, chosen for its efficient cleaning action and for

its negligible darkening effect on the many zinc base metals which are cleaned.

## Phosphate Coating

As the cleaned parts emerge from the washer (Station 2) those which are to be finished are transferred to the conveyor chain which carries them through the phosphate coating machine and later past the spray booths. The entrance to the phosphate coating machine may be seen in the background of Figure III. Parts scheduled for plating or for direct assembly receive no phosphate treatment and are separated and racked for delivery to their respective places in the production line.

The application of the phosphate coating, to provide a corrosion resistant and paint receptive surface, follows a cycle of four steps, each of which is automatic and continuous as the parts are carried through the various zones of the machine on the conveyor chain. The cycle includes in order: 1. a chemical spray of sixty seconds which produces the coating; 2. a cold water spray rinse of forty-five seconds duration to remove the chemical solution; 3. a hot water spray rinse of forty-five seconds to remove remaining traces of chemicals and prepare the metal for drying;

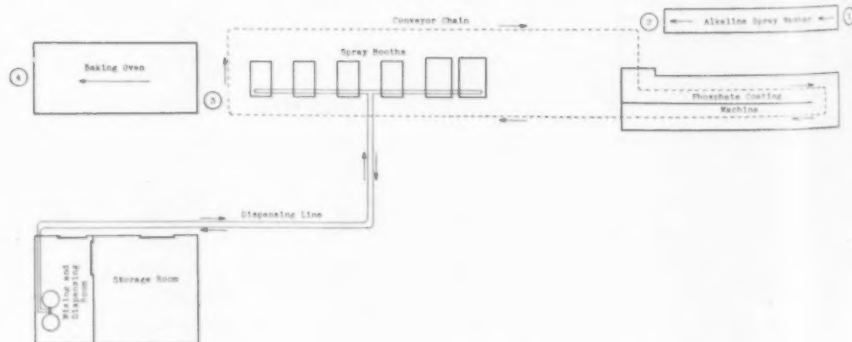


Fig. 1. Diagram of processes in finishing washing machines.



Fig. 2. Entrance to alkali washing machine.



Fig. 3. Discharge end of washing machine and entrance to phosphate coating machine.

1. a drying period in which all water is removed by hot, recirculated air.

In each of the spray zones of the phosphate coating machine, carefully designed nozzles are, so arranged as to produce an enveloping mist, thus assuring complete reaction on all sections of the parts being processed. Steam is used for heating the air of the drying chamber and for maintaining the operating temperatures of the chemical solution and the hot rinse water.

### Spraying

Parts which have received the phosphate coating remain on the conveyor chain and pass to the spray booths, as noted in Figure I. As the spray booths are reached, the parts are removed by the spray operators who apply the finishing material and return them to the conveyor chain which continues past the loading end of the baking oven. The spray booths, six in number, are of the water-wash type. Each is equipped with separate ex-

haust system, air and fluid pressure gauges, overhead daylight lamps and such fixtures as are necessary for those parts assigned to any particular booth.

The finishing material, a white alkyd modified urea-formaldehyde baking enamel of high solids content, is applied at an air pressure of eighty-five pounds per square inch and a fluid pressure of fifteen pounds per square inch. No priming or intermediate coats are used. The parts are given a mist coat which is immediately followed by a full coat



Fig. 4. Spraying of washing machine skirt and leg assembly on a rotating table.

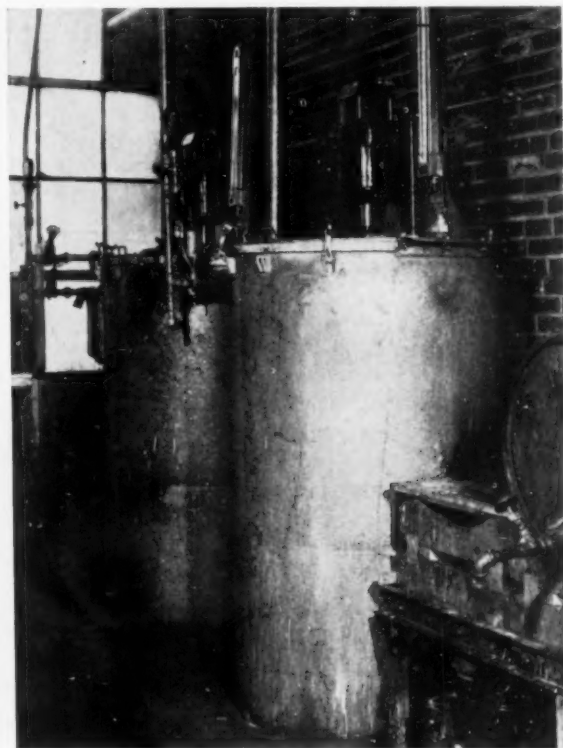


Fig. 5. Central mixing and dispensing tanks.



to produce the required film thickness. A central mixing and dispensing system supplies the spray booths with the finishing material at constant pressure and viscosity. The enamel is constantly recirculated and filtered and may be drawn from either or both of the two tanks, each of one hundred and fifty gallons capacity, shown in Figure V.

### **Baking**

At Station 3, parts which have been sprayed and returned to the conveyor chain are transferred to the bar conveyor of the oven, where a short cycle, high temperature baking schedule is followed. The oven is a gas fired, recirculating air type, internally baffled to give a preheating, baking and a cooling section. The baking cycle requires only slightly more than one-half hour, with the preheating and cooling zones each occupying one-sixth and the baking zone occupying one-third of the total time. Constant temperatures are maintained by a bank of five thermostatically controlled burners and the average temperature is continuously marked on an automatic recorder. Included in the accessory equipment are an automatic lubricating system and an electric eye across the conveyor at the exit to prevent parts from being carried back to the loading station.

On emerging from the oven (Figure VII) the parts are carefully inspected for color and finish defects at Station 4 with the aid of a large overhead daylight lamp which illuminates the unloading and inspection area. Those parts which pass inspection are racked and delivered to the assembly lines.

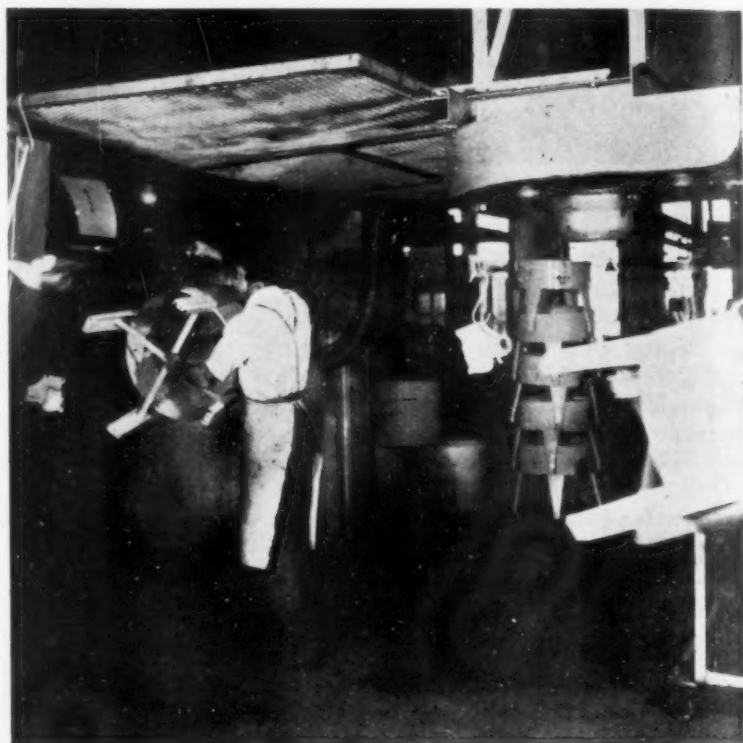
### **Control**

Early experience in the application of one coat white organic finishing materials proved that each part of the procedure must invariably follow operating specifications if the finishing line was to function smoothly. As a consequence, each part of the system is exactly controlled through periodic checks. For example, conveyor speeds on the washing machine, the phosphate coating machine and the oven are regularly timed. Temperatures are closely watched throughout each day and the solutions of the washing machine and the phosphate coating machine are analyzed a number of times each day. The viscosity and the tempera-

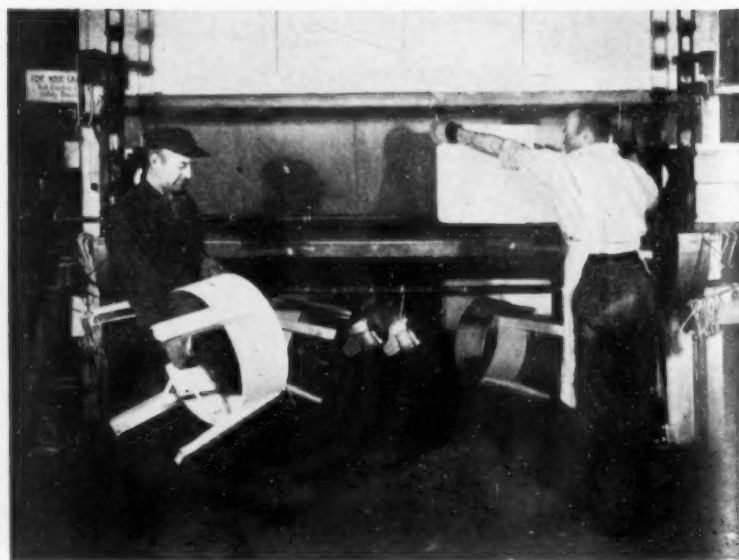
ture of the finishing material is constantly checked, along with the fluid and air pressures at the spray booths. The thickness of the applied paint film is also measured periodically. Finally, there is a constant inspection of the parts as they pass through the finishing system. Defects at any point are checked out for correction, thus assuring uniformity of operation.

To secure an approved finish on any

piece of equipment is a difficult problem, particularly where a one coat system is followed and production must be met. The finishing system described above was designed and is operated to eliminate the difficulties usually encountered. The effort of careful planning and closely controlled operation has paid dividends in a minimum of rejections and in the economical application of a fine finish.



*Fig. 6. Loading end of oven.*



*Fig. 7. Unloading and inspection of parts emerging from oven.*

# Storing, Mixing and Reducing of Organic Finishing Materials\*

In the successful use of finishing materials, there are two important factors:

1. Care in storing.
2. Preparation for use.

Correct methods can be established easily, and will aid greatly toward an efficient finishing department.

Note: Mark all containers of finishing materials with the date on which they are received and *use the oldest material first*.

## Storing

A temperature of 60° F. or over should be maintained in storerooms for varnish, enamel, japan, lacquer and synthetic products.

Where necessary to store in cold places, or when goods are received in cold weather, bring into warm room a few days before using. A drum of chilled material will take several days to warm through. Material in a one-gallon or a five-gallon container will reach room temperature sooner than that in a drum. If it is necessary to use some material before it has reached room temperature, mix thoroughly, draw off the portion needed and warm it before using.

Cold material will be heavy in body and hard to reduce for use. Reducers and thinners should be used only at room temperature or higher. Partial separation of cold material may occur when reducer is added; such separation will cause specky work, and with baking goods, may cause pock-marks in the finish.

## Work Room Storing of Materials

### When Not in Use

Materials in the paint shop, unre-

\*This paper has been reprinted from Bulletin M-A of the Varnish Corporation, Brooklyn, N. Y.

Difficulties with the use of organic finishing materials have been traced, in many cases, to improper storage or mixing of the material. This paper is based on many years of intimate contact with finishing problems, and contains much practical and valuable information. Suggestions for storing, mixing, reducing and testing of lacquers, varnishes, enamels, japans, etc., are made.—Ed.

duced as well as reduced, when not in use, should be kept in containers as nearly full and as air-tight as possible. This prevents thickening of the material, decreases oxidation of the oils and prevents evaporation of the thinner.

Note: it is false economy to purchase finishing material in larger containers than can be used in a reasonable time. Do not buy in 5-gallon cans unless same can be used within one week. Do not buy in half drums or drums unless 30 to 55 gallons can be used within one month.

### Mixing—In the Original Container

Clear varnish and clear lacquer contain no pigment and need no mixing or stirring before drawing from the original container.

Flat varnish, white, black and col-

ored enamel; pigment black japan; rubber finish japan; clear flat lacquer; colored lacquer; colored synthetic; pigmented pastes and semi-pastes—all these contain pigment and should be thoroughly mixed before taking any part for use.

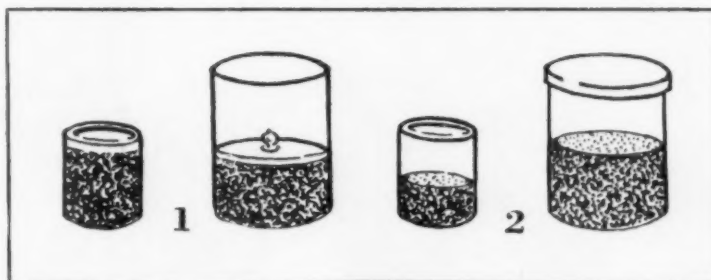
Much of the troubles and unsatisfactory results with pigmented goods can be traced to insufficient mixing. If mixing is incomplete, the product will be thin on top and thick on the bottom; the color will be off shade; the lustre of the finish obtained from the top will be too glossy and, from the bottom, too flat or dull; the hiding of the material from the top will be poor and, from the bottom, better than standard.

Pigment will not stay in suspension indefinitely. Therefore, pigmented products should be stirred thoroughly until uniform, before they are used.

### Mixing by Hand

Where hand mixing must be used, the method illustrated and described below will be found effective.

## RIGHT AND WRONG WAY TO STORE MATERIALS

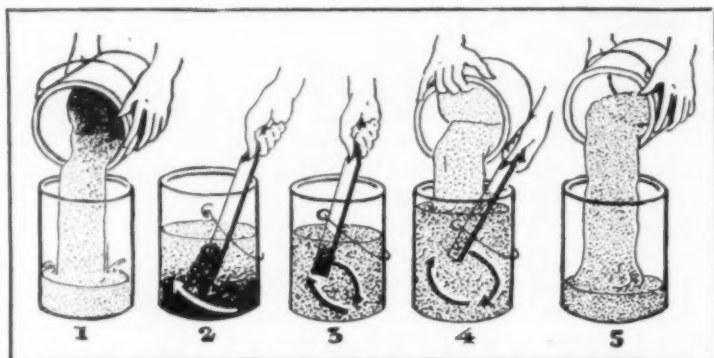


1. RIGHT WAY

to keep material when not in use. In full containers or in tanks with cover sitting directly on top of material.

2. WRONG WAY

to keep material when not in use. Large air space between cover and material.



*Proper hand mixing of material.*

1. Pour off  $\frac{1}{4}$  of contents into another clean can.
2. Then with a wide paddle, loosen any settled pigment.
3. Mix thoroughly, using a lifting and beating motion.
4. Gradually add liquid poured off, mixing as in number 3.
5. Complete mixing by pouring back and forth from one can into the other.

### *Removable Head Drums and Half Drums*

Do not try to mix through the bung hole; it cannot be done properly. Remove head of drum and use it as a cover. For stirring, use a strong paddle, 5 or 6 inches wide and 2 to 3 feet longer than the drum. Follow the illustrations.

Repeat all operations, change starting position of paddle after each lift, gradually moving around the drum. Continue until sure that material is mixed to even consistency throughout.

Mixing in the drum, can be greatly aided by taking out about one-fourth of the contents, mixing the remainder thoroughly, then adding the part previously drawn off and mixing again, as suggested for mixing in cans.

### *Drums Equipped with Stirring Device*

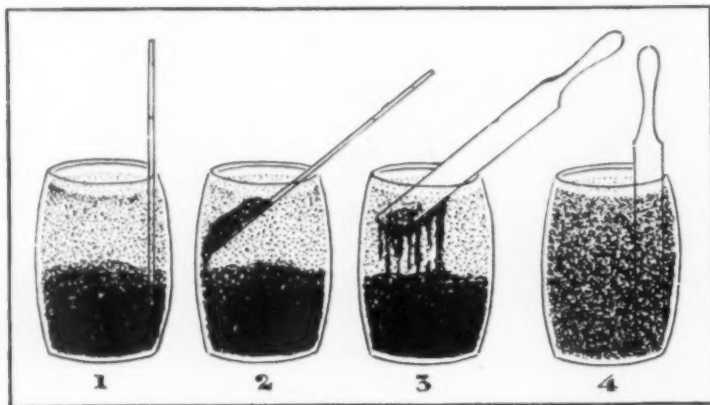
Much pigmented goods — enamel,

japan, lacquer and synthetic — except semi-pastes, are shipped in drums equipped with stirring devices.

To avoid too great a strain on mixing bars, loosen material by rolling barrel for a few minutes; then use the stirrer, rotating the handle clockwise, starting slowly and gradually increase speed. Stir until material is of uniform consistency throughout, stir frequently when standing unused; and always stir before any material is removed from the drum. Some users have a power drive which is connected to the stirrer in the drum by a flexible coupling.

### *Mechanical Mixing in Original Container*

Goods may be mixed mechanically in the original container, by removing the top and inserting a stirring device. This may be stationary or portable.



*Mixing of material in drums.*

1. Push paddle to bottom of drum, keeping flat side against side of drum.
2. Pull handle toward you, lifting pigment nearly to the surface.
3. Twist paddle to the right, throwing pigment off the paddle.
4. Bring paddle back edgewise to position number 1.

### *Using Tank with Mixing Device*

The contents of an original package may be mixed by emptying into a tank which has a mechanical mixing device and mixing thoroughly. Where material to be mixed has settled appreciably in the original container, it is advisable to take off the lighter portion from the top and put the heavy portion from the bottom into the mixer; mix thoroughly, then add the lighter portion gradually, mixing constantly until the whole mass is uniform.

### *Reducing or Thinning*

Most finishing material is shipped at a consistency or body that is heavier than the body at which it is used. This gives a flexibility in its use, and in pigmented goods lessens the amount of settling. Such material must be reduced for use and if pigmented, must be thoroughly mixed before reduction.

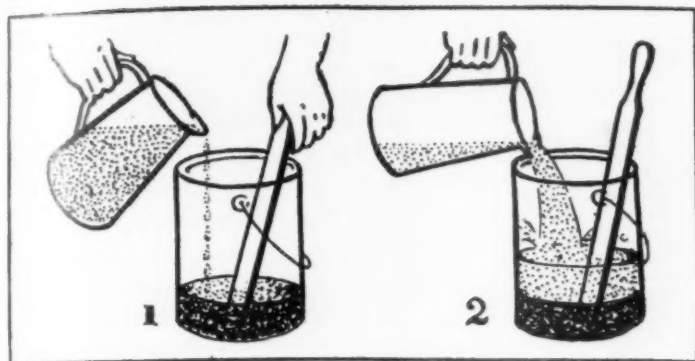
The reducer should be added slowly and gradually, meanwhile stirring vigorously to insure a quick and thorough incorporation of the reducer with the material being reduced. When a large quantity of reducer is added at a time, it may float on top and require much longer time to mix well than when added gradually. If not thoroughly mixed, the reducer may cause a separation which will give a gritty appearance. The material to be reduced and the reducer should be at a temperature of 60° F. or higher.

Use only the reducers and thinners recommended as compatible with his product by the material manufacturer of the decorative coating. The wrong reducer may not mix properly, causing separation of the material which may be responsible for pock-marking; or cause jelling and render the material worthless.

### *Mixing of Reduced Material*

Reduced material which has thickened by loss of thinner, due to exposure, will require further reduction. Reduced pigmented material should be kept thoroughly stirred while in use. Unless the pigments are uniformly distributed throughout the mass, the correct tint or shade, the correct lustre, and uniform hiding will not be obtained.





1. RIGHT WAY

to add Reducer, gradually while stirring.

2. WRONG WAY

to add Reducer, all at once.

*Right and wrong methods of adding reducer.*

### Material in Dip Tanks

The reduced material in the dip tank should be stirred frequently while the tank is in use to assure uniformity at all times. To the material in the dip tank, it is necessary to add the reducer to replace that which has evaporated, and at the same time add new material and new reducer to replace the goods used. When not in use, dip tanks should be kept closed air tight,

preferably with covers close to the surface of the liquid.

Note: When the dip tank is in frequent use, it is advisable to work the material down to a minimum about once a month, clean out the tank and start with fresh goods.

### Test for Thorough Mixing

Compare, on clean glass, the finishing material taken from the very top of the container with that taken from

the bottom. Place the same number of drops of each, side by side, and set the glass in a vertical position until the flow stops.

Note: If no other means are at hand, for taking a sample from the bottom of the container, take a rod or paddle long enough to reach the bottom, insert into the container from the top down to the bottom and withdraw. After draining for a minute or two, take a little of the material from the extreme end which has been in contact with the bottom of the container. If the samples from the top and bottom are identical in color, covering and flow, the material has been properly mixed.

Color can be compared by looking at the films.

Covering can be compared by looking through the films. If the material is properly mixed, both samples should flow the same distance. If samples do not match, mix again and repeat the test.

Note: This test is equally effective in checking both the uniformity of goods in the original container and of reduced goods.

## Paint Films of Controlled Thickness\*

By H. G. Arlt

Bell Telephone Laboratories, Inc.,  
New York

In the preparation of paint films for test purposes, control of the thickness and uniformity of the coatings applied to the test panels is of extreme importance since the value of the results of exposure, corrosion and physical property tests depends so largely on the duplicability of the films and their relation to the coatings applied in actual use.

Studies in our laboratories show that coatings prepared by brushing may vary in thickness several hundred per cent under the same conditions and as much as 100 per cent over a single surface even when applied by an experienced operator. Hand spraying gives somewhat more uniform results but still shows objectionable variations in thickness and uniformity. To ob-

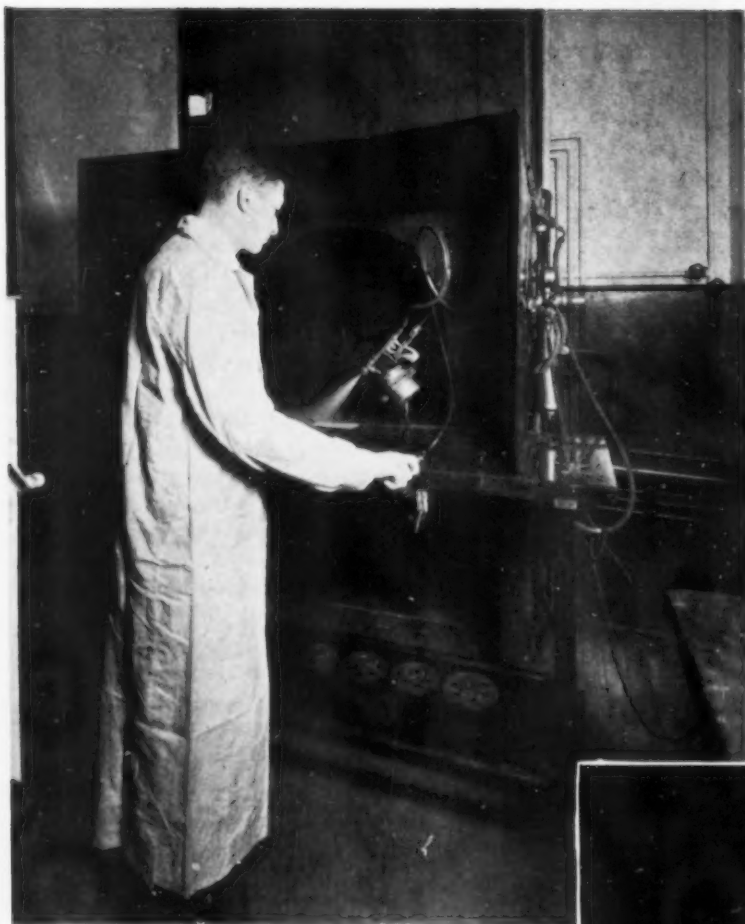
tain improved control, we developed an automatic spraying device which may be used to apply organic coatings of all types. It has been the custom in the past to prepare panels intended for exposure or other tests largely by brushing and spraying. More recently such test panels have been made by spinning. The procedure in this case is to pour the coating material on a panel which is rotated rapidly in a horizontal plane. By controlling the speed and time of

rotation, and the consistency of the finishing material, coatings which are uniform within 0.0001" over the entire area except within perhaps 0.25" of the edge of the panel can be obtained. This method of application is limited to single coats except for materials in which the solvent action of the second coat does not soften the first coat and cause a secondary flow. Also, it is not possible by this procedure to produce uniform coatings of finishing materials which contain heavy pigments since radial striations usually occur in the film as a result of the centrifugal forces that are exerted by spinning on the heavy pigment particles.

The automatic spraying machine developed at our laboratories overcomes these limitations. It employs a spray

gun.—Ed.

\*Reprinted from Bell Laboratories Record.



*Fig. 1. The spray gun is moved automatically at a uniform rate over the panel to be finished.*

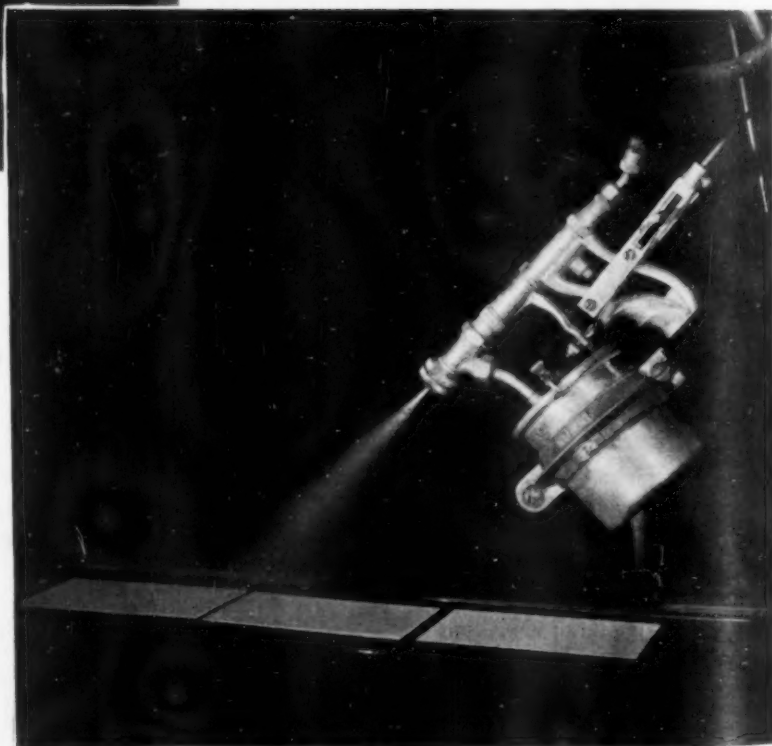
gun of standard type which is mounted so that it moves at a uniform rate past the panel to be finished. The panel lies on a leveled horizontal surface and the spray gun travels back and forth above it on a reciprocating carriage which is motor driven. The width of spray emanating from the gun is set at about 5 inches at the panel level by adjusting the vertical arm on which the gun is mounted, but only the central three-inch portion of this spray fan is ordinarily used. The speed of travel of the gun can be changed easily and quickly by changing gears. The entire arrangement is mounted on a portable table so that it may be located in front of a spray hood to remove objectionable fumes.

There is a straight line relation between film thickness and the speed of travel of the spray gun with given spray conditions and consistency of material. The usual procedure is to

depend on changes of gun speed to control the thickness of the film. The selection of the speed of travel required to give the film thickness desired within 0.0001" or 0.0002" can be found by making a single preliminary trial to determine the thickness of deposit obtained at a known speed.

The automatic spraying machine is constructed so that a number of panels can be sprayed at the same time. This is of particular advantage in cases where it is desired to prepare a series of panels with coatings of different thicknesses of the same finishing material. In such cases, it is customary to spray a row of panels and remove one after each pass of the gun.

The development of the automatic spray device for preparing uniform organic films for test purposes has not only been of value in facilitating studies of finishes with respect to thickness, but has decreased the expense of preparing test films by approximately 75 per cent.



*Fig. 2. Several panels can be sprayed simultaneously.*

# A Modernized

## Finishing Department

By John R. Williams

*Finishing Engineer,  
Chicago, Illinois*

A modern plant for finishing steel cabinets with both lacquers and enamels is described. Modernization has resulted in time saving, more orderliness and a better finish.—Ed.

In the various steps of finishing processes, proper equipment and rigid adherence to each detail are highly essential if the completed product is to come up to standard quality. To overcome many difficulties and much confusion in its finishing department, a Mid West concern manufacturing steel cabinets of all kinds, has revamped its entire finishing department to bring it up to present-day operating standards and to improve the products.

To meet the demand for modern finishing practice, the company installed a circulating paint system, which serves spray gun stations at two water-wash spray booths, one using three lines of baking enamel, and the other seven lines, three of which are for baking enamel and four for synthetic enamel. The cabinets which are to receive their finishing coat are carried suspended from an overhead conveyor through their respective spray booths and on through one of the two thermostatically controlled ovens, according to which finish is desired. Each oven is about 40 ft. long.

This modern equipment has superseded the older method of using dry type booths. These, when the company started in business from a rather small beginning, were added to from time to time as requirements demanded until eventually there were twenty-one of them scattered throughout the finishing room, occupying much space. The department was further inconvenienced by the neces-

sity of moving the pieces to be coated from place to place without any logical system and without conveyors of any kind. There were box type drying ovens. In addition, all products were room dried for eight hours, still further cluttering up the place. Much of the confusion caused was owing to the fact that different types of finishes and seven different colors had to be applied, with the coating material handled in individual portable pressure tanks.

Under the modernized system, the products come from the production department and are thoroughly inspected and carefully wiped with oleum spirits before being routed through their respective spray booths and ovens.

There are two distinct continuous conveyor lines, each serving its own spray booth and oven. At the central loading point, those products which are to be finished entirely in baking enamel, are placed on hooks extending from the overhead conveyor which takes them through the booth having four stations and three color lines, supplying baking enamel in white, green and ivory. Single door cabinets and small pieces are hung on consecutive hooks; double door cabinets, requiring more space, are hung on every other hook.

### *Spray Booths*

Products requiring two types of finish are sent on the other conveyor line, running parallel to the first but passing down and around the back of the three-line booth and into the other water-wash booth (which is adjacent but at right angles to the other) and is served by seven circulating paint lines, three of which are white, green, and ivory baking enamel and four of which are white, green, ivory, and brown synthetic enamel.

Each of the water-wash spray booths is 35 ft. long and provides spraying equipment for four operators. Two 20-hp. pumps, one on each booth, supplies water for the curtain and the wash nozzles behind the curtain. The exhaust for each booth is supplied by 3 5-hp. 42-in. diameter fans. The velocity of air through the booths is in excess of 165 f.p.m. Close control of the amount of water-wash chemicals has resulted in paint pigments floating to the surface. This, in turn, has tended to lengthen the intervals between the clean-up periods of the water-wash chambers.

Each booth is designed with its top



*Looking toward the three-line booth, operators spray painting inside of cabinets.*



recessed more than normal, and with a protective partition back of the operators of sufficient height to give the proper direction to exhaust air, thus providing better protection to operators when spraying the inside of cabinets. So thoroughly are the fumes exhausted that it has never been found necessary for any of the spray operators to use a mask or other protection.

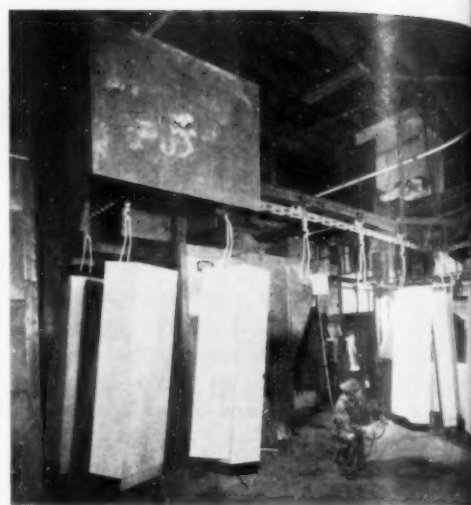
### Paint Dispensers

The paint mixing room is located at the rear of the booth which is supplied by seven pipe lines, and is contiguous to the paint receiving and storage room. In the mixing room is a row of eight 130-gal. tanks—two tanks of white, because of added requirements of that color, and one each of the other six colors. The paint in each tank is agitated by a double paddle agitator, driven by explosion-proof motors. The paint lines are of  $\frac{3}{4}$ -in. galvanized pipe, all elbows being eliminated by resorting to 45° or 90° large radius bends. Pumps, especially designed for handling paint, circulate the paint from the pumps through a manually operated self-

cleaning filter and through the pipe line to the spray booth stations. Each pump is driven by a 1½-hp. explosion-proof motor.

At the various stations, each color line is equipped with a paint hose and gun for its particular coating material, either synthetic or baking enamel. The main air line passes through a large type H.P. condenser some five feet long for removing all oil and moisture to a master air regulator. This condenser eliminates as far as possible all foreign matter, while the master regulator permits all sprayers to have the same air pressure. The take-off at each station is from the top of this main line, still further overcoming the possibility of foreign matter passing through the guns. The air hose at each station is equipped with quick detachable connections to facilitate the speedy interchange of guns for the respective colors.

When a change of color is desired on all work immediately to follow through the booth, a flag is placed on one of the conveyor hooks. This attracts the attention of the operators and gives instructions as to what color is desired. If colors other than



*Applying japan finish on recessed base of cabinets just before they enter drying oven.*

those circulated through the system are to be applied, these are supplied in individual pressure tanks. Some of the cabinets made at this plant are designed with a recessed base. These bases are enameled just before the cabinets enter the drying oven. In this way the bases are subjected to the same degree of heat and for the same period as the other surfaces of the cabinets.

### Ovens

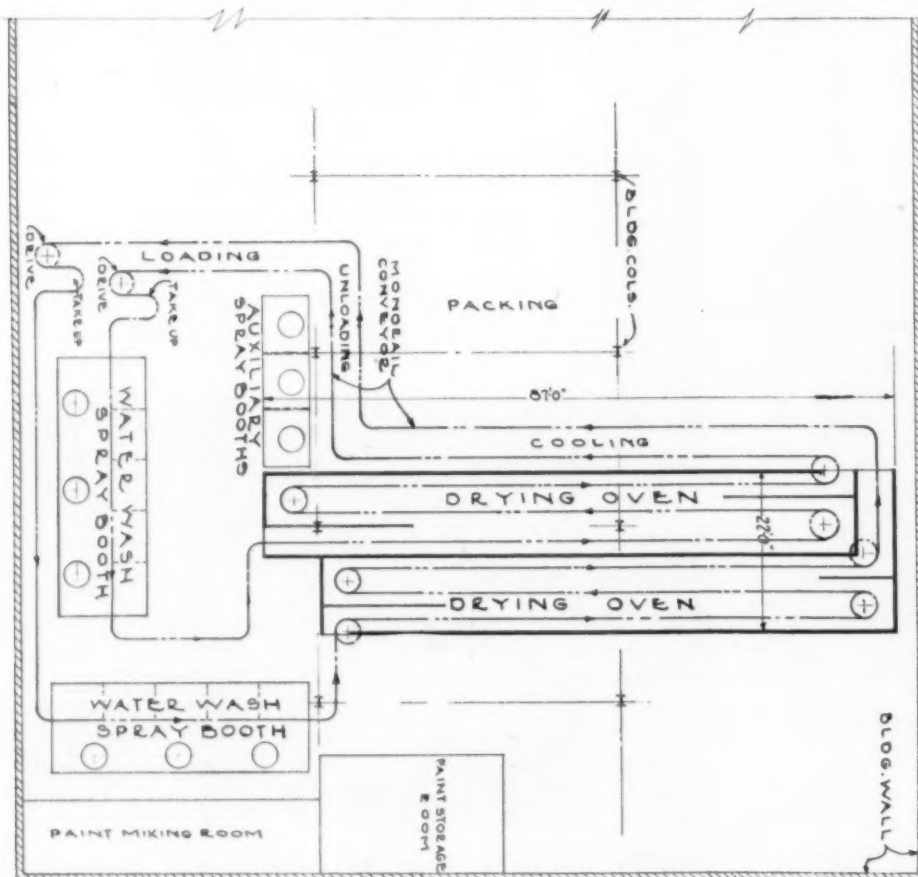
A separate oil-fired oven serves each of the two spray booths, each oven being for a definite type of work,—i.e. one for the baking of enamels and the other for synthetic. These ovens are erected adjacent and parallel to each other, the finished pieces making three complete passes within the oven as they travel along on suspended hooks from the overhead conveyors, taking approximately one hour to make the trip through the ovens. The speeds, however, can be varied by means of a variable speed drive on each conveyor.

The ovens are oil-fired, and the two heating units are similar in size. The heating units consist of a special type of indirect fired heaters having cast-iron interchangers which are very efficient and have a long life.

One oven operates at a temperature of 250° F. and the other at 175° F. but the heating units are so arranged that either oven can operate at higher or lower temperatures.

### Sequence of Operations

The conveyors are so arranged that, after completing the passage through  
(Concluded on page 129)



*Plan view of paint finishing system.*

# Solvents in Industry

## Acetone

(Dimethylketone, Propanon, Ketopropane, Dimethylketal, Methylacetyl, Pyroacetic ether)

### Physical Properties

Acetone is a neutral, colorless and highly flammable liquid having a characteristic ethereal odor. It is a member of the ketone group of organic compounds and has the formula  $\text{CH}_3\text{COCH}_3$ . The molecular weight is 58.048.

Acetone is completely soluble in water and is miscible with most organic liquids. It is an exceptionally active solvent for many organic gases and solids, including acetylene, camphor, fats and greases, gums and resins, vegetable oils. Acetone acts as a common solvent, or coupling agent, to produce miscible and homogeneous solutions from non-miscible solvents. It also possesses the power of selective solution and selective precipitation.

The volatility and flammability of acetone are among the highest of the organic solvents. Its volatility (compared with ethyl ether taken to have a value of 1) is 2.1 and its flash point is less than 20° C. The vapor pressure, even at moderate temperatures, is quite high.

Acetone is listed as having a specific gravity of 0.792 at 20/20°C., a boiling point of 56.1°C. at 760 mm. pressure, a melting point of -94.3°C. at 760 mm. pressure, a vapor pressure of 185 mm. of mercury at 20°C. and a complete solubility in water.

### Chemical Properties

By means of alkaline catalysts, acetone is readily converted into diacetone alcohol.

Mesityl oxide can be prepared directly from acetone and by reduction is converted into methyl isobutyl ketone.

Bleaching powder converts acetone into trichloroacetone, which may be decomposed into chloroform and acetic acid.

With formaldehyde, acetone forms methylene acetone by the elimination of water.

Acetone is also used as a raw material in the manufacture of iodoform, sulphonal, indigo and certain resins and plastics.

### Physiological Properties

Acetone has found some use in the disinfection of hands and for cleansing the skin before surgical operations. Its medical action is that of a mild alterative, an antispasmodic and an antidyspneic. It is also used in certain liniments for rheumatism. Acetone, like many organic solvents, causes drying of the skin through the removal of natural oils. When inhaled in large quantities it may cause irritation and headaches.

### Manufacture

By passing the vapor of acetic acid over

hot catalysts such as wood charcoal or alumina, acetone of high purity and uniform quality is obtained. In a similar catalytic process, acetylene and steam may be made to produce acetone. Still another process uses isopropyl alcohol which is dehydrated to form acetone by treatment with catalysts at elevated temperatures.

The destructive distillation of wood, by means of which methyl alcohol is obtained, also produces acetone. On the addition of lime to the products of the wood distillation, a separation occurs and "grey lime" results. This grey lime bears the active ingredients of acetone and other ketones. On heating the grey lime, carbon dioxide is removed and the mixture of ketones is purified to separate the acetone.

The fermentation process for normal butyl alcohol, discussed in a previous issue of ORGANIC FINISHING, has acetone as one of the products.

### Uses

Acetone finds its greatest use in industry as a solvent. For example, it is employed in large quantities as a solvent for acetylene gas which is to be used for welding and lighting purposes. Because of its purity,

solvent power and volatility, it is widely used in the extraction of essential oils, drugs, etc. In connection with its solvent power, and particularly its ability to selectively dissolve certain substances, it is used in many refining, purifying and separating processes, including the dewaxing of lubricating oils and the reclaiming of rubber.

Acetone is a constituent of various finishing materials, paint and varnish removers, dry cleaning materials, nail polish removers and liniments and is an approved denaturant for ethyl alcohol. It is used in the processing and manufacture of safety glass, film, plastics, cements, synthetic resins and numerous other materials.

### Solubility of Acetone with Various Substances

Ethyl Alcohol	Soluble
Ether	Soluble
Toluene	Soluble
Gasoline	Soluble
Linseed Oil (raw)	Soluble
Cellulose Acetate	Soluble
Shellac	Partly Soluble
Kauri Gum	Partly Soluble
Dammar Gum (dewaxed)	Soluble
Ester Gum	Soluble

Tung oil will be studied as a new Federal research project under the Department of Agriculture. Experimentation will be carried on to determine a method for extracting tung oil with solvents to replace the squeezing methods as employed by the Chinese.

### Standard Specifications for Acetone Properties

A.S.T.M. Designation: D 329-33

Issued as tentative, 1931; Adopted, 1933

#### 1. Acetone shall conform to the following requirements

Purity	not less than 98% dimethylketone
Specific gravity, 20°/20°C.	0.791 to 0.799
Color	water white
Distillation range: (a)	
Below 55.0°C.	none
Above 57.5°C.	none
Non-volatile matter	not more than 0.005 g. per 100 ml.
Water	miscible without turbidity with 19 volumes of 60° Baume gasoline at 20°C.
Acidity (free acid as $\text{CO}_2$ )	not more than 0.002%, equivalent to 0.051 mg. KOH per gram of sample,
Water solubility	miscible with distilled water in all proportions
Alkalinity	not alkaline to para-nitrophenol
Potassium permanganate test	color of added potassium permanganate to be retained at least 30 minutes

### Methods of Testing

- The sampling and methods of testing shall be conducted in accordance with Standard Methods of Sampling and Testing Lacquer Solvents and Diluents (A.S.T.M. Designation: D 268) of the American Society for Testing Materials.
  - The thermometer used for the distillation test shall conform to the requirements of the Standard Specifications for A.S.T.M. Partial-Immersion Thermometer for General Use, -20 to +150°C., 0 to +300°F. (A.S.T.M. Designation: D 182) of the American Society for Testing Materials.

# NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

## Measuring Instrument

The American Instrument Co., 8010 Georgia Ave., Silver Spring, Md., have announced an improved Magne-Gage for measuring the thickness of organic coatings, including paints, varnishes, lacquers, japans, as well as vitreous enamels and metal coatings, which are deposited upon magnetic metals.

The improvement in the new instrument over the instrument introduced in 1937 is the ability to measure various types and thicknesses of coating with only one instrument by simply interchanging different types of magnets.



*Magnetic thickness gauge.*

This instrument is said to enable rapid determination of the thickness of the coating without any harm to the coating itself. It can be used for measuring the thickness on variously shaped articles, and is easily transported. The measurement is based on the loss of magnetic attraction between a permanent magnet and the base metal with decreasing attraction as the thickness of coating increases. The instrument is readily calibrated to suit various ranges of thickness.

Bulletin No. OF 2070 is available describing this instrument.

## New Finishes For Plastics

The Sherwin-Williams Company of Cleveland, Ohio, announces the development of Kem Plastite Enamel, specially formulated for finishing plastic materials, and designed to provide thorough adhesion to the hard surface of plastics. Tests on a wide variety of plastic formulations indicate that this finish withstands severe abrasion and impact without marring or chipping—characteristics in which most ordinary baking enamels have proven deficient.

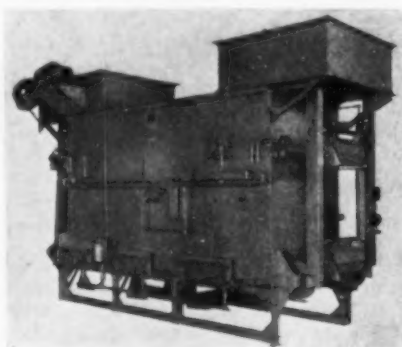
Another finish known as Kem Bakolescent Enamel has also met instantaneous acceptance, it is said, because of the beauty, richness and depth of tone afforded by the opalescent particles, combined with the fact that it is believed to be the first enamel of this type that could be baked without occurrence of unsightly flooding. It also shows extraordinary adhesion to most plastics, it is said. A slight variation in the finish formulation may sometimes be recommended by the company for best results in finishing certain moulding compounds.

Advantages claimed for the use of color finishes on brown plastics in place of using color plastics are threefold: First, there is a very considerable saving in spray applying colors to the cheaper brown plastic material. Second, the appearance is generally superior, and richer colors are possible. Third, manufacturers are enabled to produce all plastic objects in the one cheaper compound, and spray on whatever color is in current demand. There is no danger from over-producing an unpopular color in plastic merchandise.

## Degreaser for Cleaning Cupped-Shaped Objects

A three-compartment degreaser with a hot solvent wash, cold solvent rinse and final rinse in pure hot concentrated vapors, has been developed by G. S. Blakeslee & Co., 19th St. and 52nd Ave., Chicago, Ill.

This particular degreaser has removable rotary baskets which are for cleaning small cupped-shaped parts, which would ordinarily drag out solvent. Baskets are automatically rotated as they pass through each of the three compartments. The parts are then brought from the machine clean and dry with a minimum amount of solvent consumption. A frame provides for handling of the flat mesh baskets for cleaning the larger stampings which do not require rotation during the cleaning operation. The



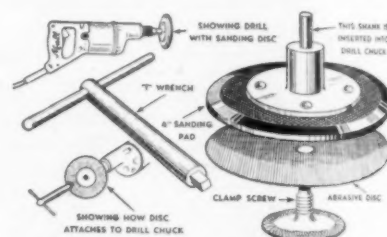
*Degreaser for cleaning cup shaped objects.*

machine is equipped with a dual vapor control for further solvent economy. Glass ports in the side of the machine are provided for inspection of the working mechanisms within the degreaser.

Steam coils are mounted on removable cleanout doors to facilitate the cleaning of the degreaser and the coils during periodic cleaning of the machine.

## Sanding Pads for Portable Electric Drills

The Mall Tool Company, 7740 S. Chicago Ave., Chicago, Ill., has introduced an improved sanding pad for use on any make, model or size of portable electric drill. This sanding pad is said to be ideal for



*Illustrations of use of sanding disc.*

doing occasional sanding jobs where the amount of work does not warrant a standard sanding machine.

The equipment consists of a four-inch sanding pad, one abrasive, a clamp screw to hold the abrasive and pad in place, and a "T" wrench to remove or fasten the pad and abrasive.

The shank on the sanding pad is inserted into the drill chuck and tightened in the same manner as the drill bit.

## New Low-Bake Finish

A new industrial finish with exceptionally low-temperature speed baking characteristics is announced this month by Ault & Wiborg Corporation, New York City.

The new finish is called Polymerin-100. This development follows the original Polymerin, a speed-bake finish introduced by Ault & Wiborg in 1938 which requires relatively high baking temperatures. The Polymerin-100 formulation, however, makes possible curing temperatures which are often as much as 100 degrees below those of Polymerin, thus extending this type of speed finish to the low-bake field.

Polymerin-100 is said to have remarkable qualities of resistance and durability, which compare favorably with those of high-bake Polymerin, except in special cases. The manufacturers say it has excellent film hardness, lustre, build, adhesion, toughness, hiding power, and color retention. It re-



sists the common deteriorants. Its general characteristics of permanence, plus its low temperature, speed baking schedules distinguish it from conventional synthetic finishes.

This new finish is expected to have application for finishing nearly any kind of metal product and some others.

The exact baking temperatures required by Polymerin-100 depend on the type and size of the oven, the mass of metal involved, and other factors, but it is claimed by the manufacturers that the curing temperatures are the lowest ever obtained for a speed-baking finish with equal properties of adhesion, flexibility, color retention, and toughness.

The low-bake finish may be used in conventional ovens. Industries and plants which could not conveniently use speed-bake finishes for the high-bake Polymerin type because of the high temperatures involved may adopt Polymerin-100 to get most of the advantages which the speed finishes provide.

Manufacturers with force-dry equipment can use Polymerin-100 successfully by stepping up their oven heats slightly.

A booklet describing Polymerin-100 in more detail may be obtained by writing Ault & Wiborg Corporation, 75 Varick Street, New York City.

### Fan With Motor Out Of Airstream

A new propeller-type fan with motor entirely outside of the airstream has been announced by the Hartzell Propeller Fan Company of Piqua, Ohio. It is designed for spray booth work and for any other installation where location of the motor in the airstream is undesirable because of the presence of inflammable fumes, extreme heat, or abrasive or corrosive elements.

The new Hartzell fan incorporates the patented Charavay Over-Lapping Ring, which, its makers say, increases the delivery of air by preventing backflow of air at the propeller tips.

The base on which the motor rests is welded to this ring, and also to a shield below it which encases the belt. This shield is so shaped as to present minimum resistance to air flow. Propeller shaft bearings are en-

tirely enclosed within a housing which is welded to the bottom of the belt shield, and two double steel supporting rods are also welded to both housing and ring.

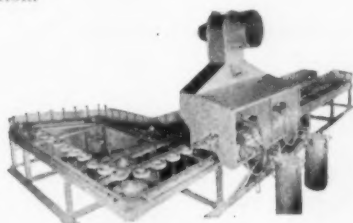
The entire unit is exceedingly simple and effective. This is particularly true of the motor mounting. The platform to which the motor is bolted is hinged to the base, and belt tension can be adjusted by raising or lowering the side opposite this hinge by simply turning a single bolt.

The standard Hartzell "Tear-Drop" propeller, recently developed and patented because it operates unusually quietly and holds air delivery well against back pressure, is used.

The new fan is built in standard sizes from 17" to 28" propeller diameter, and provision has been made for quick production of sizes other than standard on special order.

### L-Shaped Airpainting Conveyor Unit

Paasche Airbrush Co., 1909 Diversey Parkway, Chicago, Ill., have recently built an L-shaped airpainting conveyor unit for airpainting motor ends, shown in the illustration.



Unit for air painting motor ends.

This unit is used in conjunction with a continuous type high temperature drying oven. The unit is equipped with dual air-coating stations for applying primer and finishing coat. The unit has 158 rotating spindles designed so that the Paasche automatic airbrushes coat only when the loaded spindles enter the ventilating booth. Production is 24 motor ends per minute or 11,520 per 8-hour day, when conveyor is operated at an average speed of 18 lineal feet per minute.

Henry R. Fox has been appointed general field engineer of Despatch Oven Co., Minneapolis, Minn. Mr. Fox will travel out of Chicago, covering all eastern offices of the company, and will provide and give complete field engineering service in connection with all problems concerning baking, drying, tempering equipment, including layouts for the application of the new Despatch controlled combustion air heaters, and heavy duty indirect fired air heater equipment.

### Manufacturer's Literature

**Aluminum Treating Process.** The Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J., just published a well illustrated 8-page booklet describing "Pylumin", a process for treating aluminum and aluminum alloys previous to organic finishing. Advantages of this treatment are outlined and various photographs are shown to illustrate the bet-

ter qualities of the finished Pyluminized surface in comparison with finishes on untreated aluminum surfaces.

**Finish.** Ault & Wiborg Corp., 75 Varick St., New York City have published a folder on "Polymerin-100", a new low-bake finish for such products as washing machines, gasoline pumps, stoves, lighting fixtures, office equipment, kitchen cabinets, etc.

**Spray Booth Cleaners.** A folder describing spray booth cleaners developed by Wayne Chemical Products Co., Copeland & M.C. R.R., Detroit, Mich., to prevent adhesion of overspray of paint, lacquers, and enamels to spray booths.

### A Modernized Finishing Department

(Concluded from page 126)

the ovens both conveyors emerge at about the same point to pass side by side through the cooling zone. As the conveyors enter the cooling zone, the material rises some 4 feet or more, to permit the storage of shipping cartons on the floor space below. After traveling at this elevated height through the cooling area, the conveyors then dip to their original height, the finished products then being inspected on the traveling lines just before reaching the unloading station. At the unloading station, the cabinets are removed from the conveyors, packed in cartons which have previously been tested for strength and carrying power to insure safe delivery. Thereupon they are sent to the shipping room. On l.c.l. shipments, well-built crating is used where necessary.

Under the new system, the work proceeds along in orderly sequence without confusion or mishaps. No longer are there any rejects as all cabinets get the same amount of bake and temperature in passing through the ovens. Control of air and paint pressure and control of oven temperature for drying and baking insure absolutely clean and uniform finish on all the work. Rush orders can be expeditiously handled and delivery can be made the same day as received. Total finishing costs have been cut down to a minimum, and the system is operating very efficiently.

**Acknowledgment**—The author herewith gratefully acknowledges the kindness of The De Vilbiss Co., Toledo, Ohio, and Drying Systems, Inc., Chicago, Illinois in supplying the photographs used for illustration and for reading the manuscript.



Fan with motor out of air stream.

# EGYPTIAN *high-bake* N.F.R.

A tough, mar-proof, chemically resistant synthetic finish for all types of metal products . . . Extremely durable. Increases resistance to abrasion and other forms of wear so detrimental to ordinary finishes.

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Egyptian High-Bake N. F. R. comes in a wide range of colors as well as black, white, and clear. Colors are furnished in high gloss . . . Clear may be had in high or medium gloss . . . Ask for details and color chart.

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